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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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OPERATOR, ORGANIZATIONAL
DS, GS, AND DEPOT MAINTENANCE MANUAL

AMPLIFIER-POWER SUPPLY GROUP OA-2973/FRC-39A(V) AND OA-4408/MRC-98 (RADIO ENGINEERING LABORATORIES, INC. TYPES 954 AND 954B)

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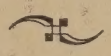

WARNING

ELECTROMAGNETIC RADIATION

DO NOT WORK ON THE RF TRANSMISSION LINES WHILE THE POWER IS ON!

High-frequency electromagnetic radiation can cause fatal internal burns. If you feel the slightest warming effect while near this equipment, MOVE AWAY QUICKLY!

Posted 5-3-74

Change No. 1

HEADQUARTERS,
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Washington, D.C., *24 October 1973*

Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual AMPLIFIER-POWER SUPPLY GROUP OA-2973/FRC-39A(V) AND OA-4408/MRC-98 (RADIO ENGINEERING LABORATORIES, INC. TYPES 954 AND 954B)

TM 11-5820-757-15, 29 January 1969, is changed as follows:

1. A vertical bar appears opposite changed material.
2. Remove and insert pages as indicated in page list below:

Remove	*Insert*
i and ii	i and ii
v and vi	v and vi
1-1 and 1-2	1-1 and 1-2
A-1 through A-4	None

3. File this change sheet in the front of the manual for reference purposes.

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NG & USAR: None
For explanation of abbreviations used, see AR 310-50.

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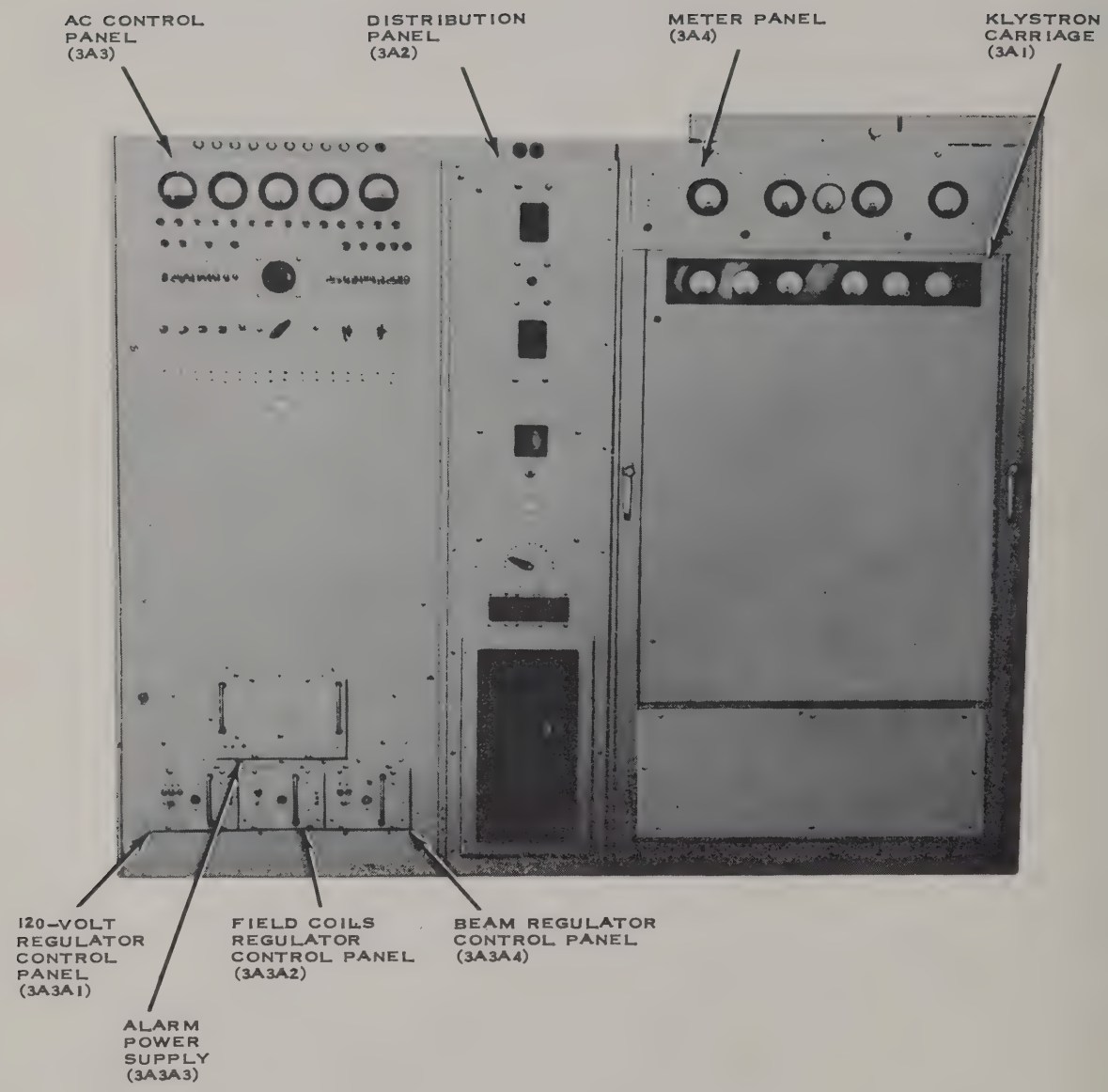

Figure 1-1. Amplifier-Power Supply Group OA-2973/FRC-39A(V) and OA-4408/MRC-98 (10-KW Power Amplifier)

CHAPTER 1
GENERAL INFORMATION

1-A.1. Scope

a. This manual includes installation and operation instructions and covers operator's, organizational, direct support (DS), general support (GS), and depot maintenance. It describes Amplifier-Power Supply Group OA-2973/FRC-39A(V) and OA-4408/MRC-98 (Radio Engineering Laboratories, Inc. Types 954 and 954B).

b. Appendix B is current as of 27 May 1968.

1-A.2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-A.3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army)/NAVSUP Pub 378 (Navy)/AFR 71-4 (Air Force)/and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army)/NAVSUP Pub 459 (Navy)/AFM 75-34 (Air Force)/and MCO P4610.19 (Marine Corps).

1-A.4. Reporting of Equipment Publication Improvements

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-C Fort Monmouth, NJ 07703.

1-1. Description and Purpose.

1-2. General.

1-3. Amplifier-Power Supply Group OA-2973/FRC-39A(V) (10-kw power amplifier type 954) and Amplifier-Power Supply Group OA-4408/MRC-98 (10-kw power amplifier type 954B), hereinafter referred to as the 10-kw power amplifier (figs. 1-1 and 1-2), is a single tube, wideband, power amplifier that provides an optimum power gain of 33 db across a 3-db minimum bandwidth of 6 mc. The 10-kw power amplifier is continuously tunable throughout a 755- to 985-mc frequency band and is operated in the fm mode of emission at an optimum and stable power output of 10,000 watts.

1-4. The extremely high gain of the 10-kw power amplifier is accomplished in a single amplifier stage that employs a five-cavity (including the input cavity), high power klystron tube. All other components of the 10-kw power amplifier are designed to operationally support the klystron tube by providing control, operating voltages, power monitoring, protection, cooling, and fault indications.

1-5. The 10-kw power amplifier functions as the final amplification stage of a radio set. Figure 1-3 shows the block diagram of a typical radio set utilizing the 10-kw power amplifier. This typical radio set provides dual transmission and quadruple diversity reception in a multiple-channel relaying system. It functions as a terminal or repeater link on any assigned frequency in the 755- to 985-mc band. The radio set utilizes wave ropagation techniques of troposcatter effects, permitting reliable communications to distances of 500 miles or more, depending upon atmospheric propagation conditions. This type of system is termed a Forward Propagation Tropospheric Scatter (FPTS) Communications System.

1-6. The exciter receives the multichannel voice and telegraph data from the multiplexer equipment via miscellaneous patching. The exciter generates an rf carrier and modulates this carrier with the input data signals. The signal is amplified in the exciter to a value of between 10 and 20 watts for application to the 10-kw power amplifier. The 10-kw amplifier further amplifies the signal to a 10-kw level and applies it through a diplexer to the antenna for transmission. For dual transmission, two exciters, two power amplifiers, two diplexers, and two antennas are employed.

1-6.1. Items Comprising an Operable Equipment

FSN	QTY	Nomenclature, part No., and mfr code	Fig. No.
		NOTE The part number is followed by the applicable 5-digit Federal supply code for manufacturers (FSCM) identified in SB 708-42 and used to identify manufacturer, distributor, or Government agency, etc.	
		Amplifier-Power Supply Group OA-2973/FRC-39A(V), 954; 77633 consisting of:	6-16
6130	1	Beam Power Supply: PT1000-OA006; 77633	6-16
5975	1	Electrical Equipment Cabinet CY-2981/FRC-39A(V): A1850-0A001; 77633	6-16
5805	1	Monitor Panel SB-1194/FRC-39A(V): A1855-OA001; 77633	6-16
6110	1	Power Distribution Panel SB-1192/FRC-39A(V): A1852-OA001; 77633	6-16
6110	1	Power Distribution Panel SB-1193/FRC-39A(V): A1854-OA001; 77633	6-16
6130	1	Power Supply Control C-3395/FRC-39A(V): A1856-OB001; 77633	6-16
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6130	1	Power Supply Control C-3397/FRC-39A(V): A1860-AC001; 77633	6-16
6130	1	Power Supply Control C-3398/FRC-39A(V): A1860-2D001; 77633	6-16
6130	1	Power Supply PP-2744/FRC-39A(V): A1857-OA001; 77633	6-16
6130	1	Power Supply PP-2745/FRC-39A(V): A1856-OB001; 77633	6-16
5310	1	Radio Frequency Amplifier AM-2752/FRC-39A(V): A1851-OA001; 77633	6-16
5950	1	Transformer, Power, Variable: PT1095-OA001; 77633	6-16
6120	1	Variable Power Transformer TF-355/FRC-39A(V): A1962-OA001; 77633	6-16

1-7. Major Units.

1-8. The 10-kw power amplifier is comprised of the following major units as depicted in figures 1-1 and 1-2; ac control panel (with subassemblies; alarm power supply, 120-volt regulator control panel, field coils regulator control panel, and beam regulator control panel), distribution panel, klystron carriage, meter panel, focus coils power supply, field coils variable autotransformer, beam power primary control, beam power transformer, and beam power rectifiers.

1-9. AC Control Panel

1-10 This panel contains circuit breakers, switches, and relays for controlling power to various power supplies, and automatic turn on and recycling circuitry. It also contains a variable autotransformer and meters for adjusting and monitoring the klystron filament voltage and current; and a meter which indicates the number of hours of klystron filament activation.

1-11. The ac control panel contains a meter for checking the input ac voltages and associated switch which selects the phase to be measured. It also has a meter which records the total time beam voltage has been applied to the klystron.

1-12. In addition, the panel contains various indicator lamps which indicate the position of

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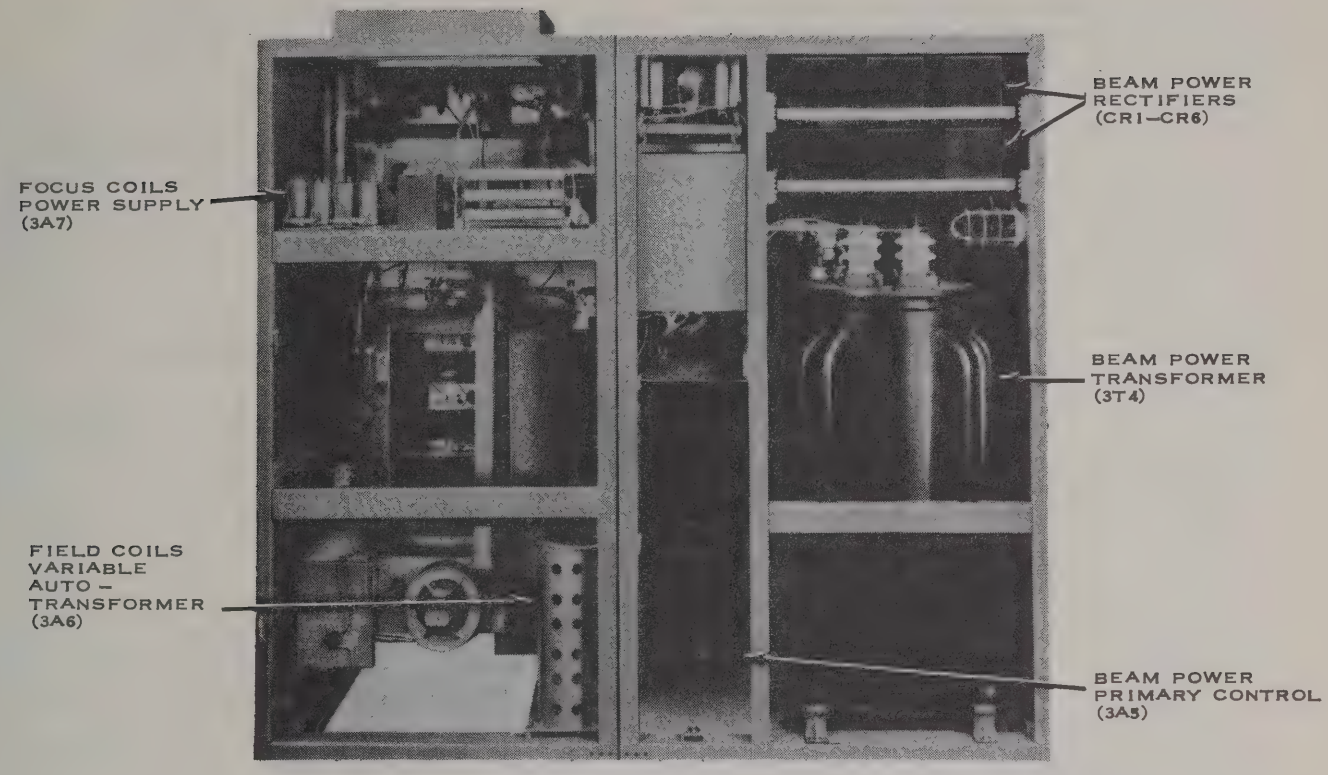

Figure 1-2. 10-KW Power Amplifier, Rear View with Panels Removed

the circuit breakers, and indicator lamps and test points which provide the operator with information concerning the status of the 10-kw power amplifier during operation.

1-13. The bottom of the ac control panel houses four removable assemblies; the alarm power supply, the 120-volt regulator control panel, the field coils regulator control panel, and the beam regulator control panel.

1-14. ALARM POWER SUPPLY. The alarm power supply contains rf alarm relays and the power supply necessary to operate these relays. The rf alarm relays in conjunction with other circuitry provide overload protection from malfunctions in the rf circuits. Additional contacts of the rf alarm relays provide connections for external alarms. The front panel of the alarm power supply is blank with the exception of test points that allow the operator to check the performance of the alarm power supply.

1-15. 120-VOLT REGULATOR CONTROL PANEL. The 120-volt regulator control panel controls and regulates (in association with the beam power primary control, para 1-30), the 120 vac supplied to the klystron tube filament prefocus coil power supply, and the getter power supply. The 120-volt regulator control panel is capable of providing regulated ac voltage to equipment external to the 10-kw power amplifier; typically, an exciter and two receivers.

1-16. Mounted on the front panel are an input power circuit breaker, a lamp which indicates the position of the circuit breaker, two screwdriver adjust controls provided for alignment, and test points. Test points are also provided on the rear of the chassis.

1-17. FIELD COILS REGULATOR CONTROL PANEL. The field coils regulator control panel controls and regulates (in association with the field coils variable autotransformer, para 1-28) the ac voltage applied to the field coil power supply. The field coils regulator control panel is basically the same as the 120-volt regulator control panel.

1-18. BEAM REGULATOR CONTROL PANEL. The beam regulator control panel controls and regulates (in association with the beam power primary control, para 1-30) the ac voltage applied to the beam power supply. This panel is also similar in description to the 120-volt regulator control panel.

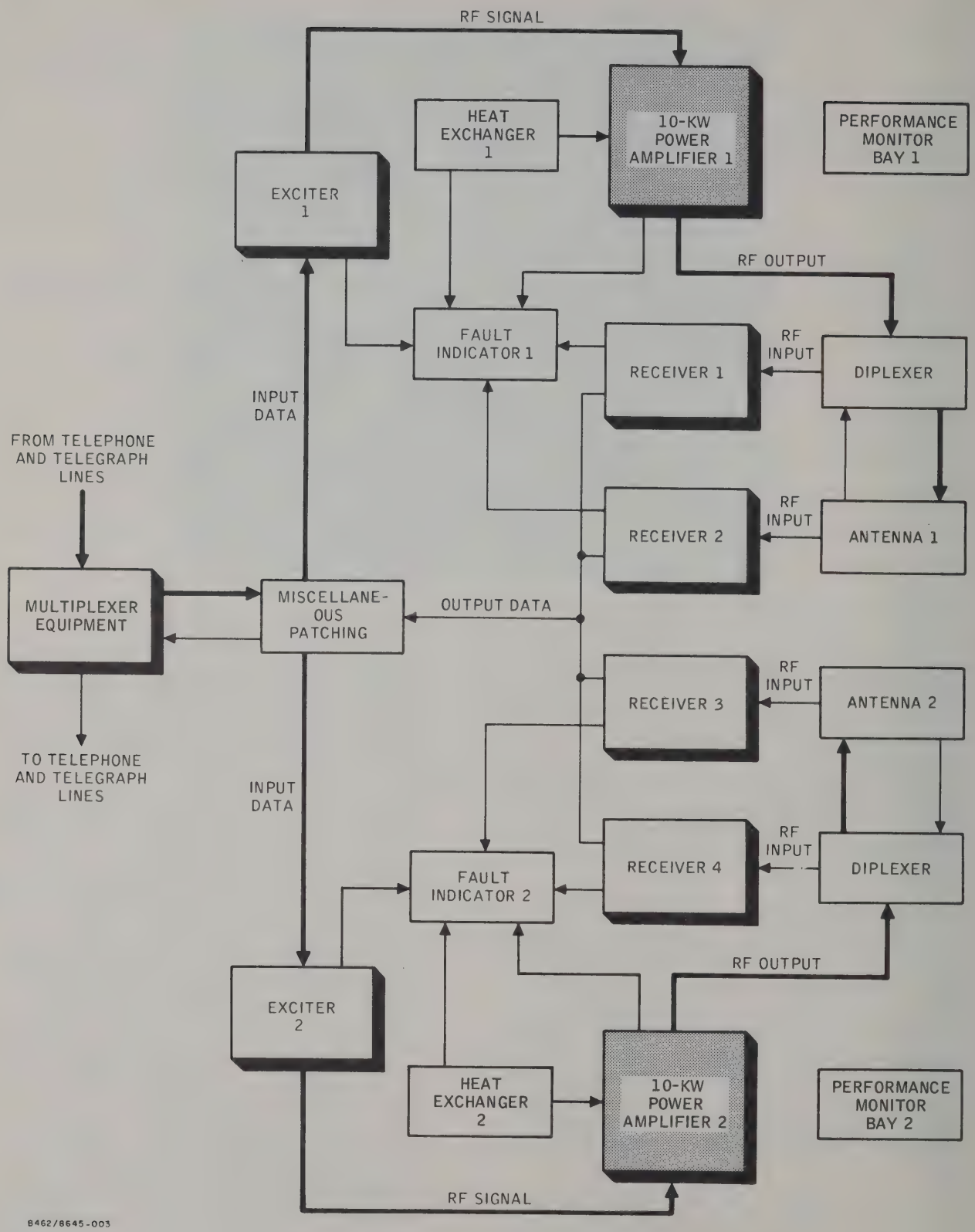

Figure 1-3. Typical Radio Set Utilizing the 10-KW Power Amplifier, Block Diagram

1-19. DISTRIBUTION PANEL.

1-20. This panel controls and monitors the bias voltage applied to the cathode of the klystron tube. It has an indicator lamp to indicate failure of the beam power supply, an indicator which shows relative position of the beam power primary control (see para 1-30), and two air circulating fans. The distribution panel also contains three circuit breakers which control and protect associated beam power supply circuitry.

1-21. KLYSTRON CARRIAGE.

1-22. The klystron carriage consists of a movable carriage on which is mounted the klystron tube, rf cavities, associated rf circuitry, and air and liquid cooling facilities. The rf signal supplied from the exciter is amplified to a 10-kw rf power level by the components contained in the klystron carriage. Pressure and thermostatic switches located in the klystron carriage prevent application of beam power in the event of a malfunction in the cooling system.

1-23. Various controls, switches, test points, and meters are mounted on the panel behind the klystron carriage door. These include cavity tuning controls, their associated meters and meter calibration controls; rf input and output meters and meter-relays, with their calibration controls; controls and switches for turning on, adjusting, and removing beam voltage, both manual and automatic; controls to adjust the prefocus coil current and position; cooling system switches, meter, and indicator lamp; and test points with their associated switch and controls used with an oscilloscope during rf alignment of the 10-kw power amplifier.

1-24. METER PANEL.

1-25. The meter panel contains four meters, a meter-relay, and three indicator lamps. These meters and the meter-relay provide indications of various klystron operating voltages. In addition, the meter-relay removes the beam voltage in the event of excessive body current. The indicator lamps illuminate to indicate particular malfunction in the rf power output circuits. The meter panel is hinged to facilitate removal of the klystron carriage.

1-26. FOCUS COILS POWER SUPPLY.

1-27. The focus coils power supply is mounted in the amplifier section in the top rear of the 10-kw power amplifier cabinet. The focus coils power supply contains the prefocus coil power supply which provides the dc current for prefocus coil operation, and the field coils power supply which provides the dc current for the field coils and the collector coil.

1-28. FIELD COILS VARIABLE AUTOTRANSFORMER.

1-29. The field coils variable autotransformer consists of a motor-driven variable autotransformer. This unit is controlled and regulated by the field coils regulator control panel (para 1-17) and provides ac power to the field coils power supply. It is located at the lower right rear (viewed from the rear) of the amplifier section of the 10-kw power amplifier cabinet.

1-30. BEAM POWER PRIMARY CONTROL.

1-31. The beam power primary control is comprised of motor controlled switches and variable autotransformers and relays. It contains circuitry for regulating the beam voltage in accordance with signals from the beam regulator control panel, and circuitry for adjusting the beam voltage in accordance with controls on the klystron carriage. The beam power primary control also contains a regulator circuit that raises or lowers klystron filament voltage in response to signals from the 120-volt regulator control panel. The beam power primary control is located in the rear of the 10-kw power amplifier cabinet directly behind the distribution panel.

1-32. BEAM POWER TRANSFORMER AND RECTIFIERS.

1-33. The beam power transformer and the beam power rectifiers make up the major portion of the beam power supply.

1-34. The beam power transformer contains a delta-wye high voltage transformer, the filament transformer for the klystron tube, and two chokes mounted in an oil filled tank. The beam power transformer is mounted on wheels so that it may be removed from the cabinet.

1-35. Six rectifier units are mounted above the beam power transformer. Each rectifier unit contains two rectifier diodes, two resistors, and two capacitors in an encapsulated unit.

1-36. INFORMATION AND REFERENCE DATA.

1-37. Table 1-1 gives the leading particulars of the 10-kw power amplifier. Table 1-2 lists the capabilities and limitations of the equipment and table 1-3 lists the equipment supplied. The common name rather than the official nomenclature of the equipment is used throughout this technical manual. For the list of equipment required but not supplied, refer to table 1-4.

1-38. USABLE ON CODE.

1-39. Table 1-3, Equipment Supplied, contains a Usable on Code column. Equipment coded A indicates that the component is used in Amplifier-Power Supply Group OA-2973/FRC-39A(V). Equipment coded B indicates usage in Amplifier-Power Supply Group OA-4408/MRC-98. The absence of a letter in the Usable On Code column indicates that the item is applicable to both models of the 10-kw power amplifier.

Table 1-1. Leading Particulars

Primary ac power	208 ±10.4 volts, 60 ±3 cps, 3-phase, 4-wire, fused at 200 amperes; and 120 ±6 volts, 60 ±3 cps, single-phase
Power consumption	52 kva, maximum
Physical characteristics:	
Overall weight (approximate)	7000 lbs.
Overall dimensions	72 in. high, 84 in. wide, 48 in. deep
Transportability:	
Air transportation	C-119 aircraft or H-21 helicopter
Road transportation	2-1/2-ton trunk
Storage conditions	Block all rolling components, such as klystron carriage and beam power transformer
Equipment reliability:	
Continuous operating life	264 hours (minimum) of trouble-free operation
Minimum operating life	24 hours a day for one year with only normal maintenance and no major overhaul
Starting time (full power output)	5 minutes after application of primary power, within 3 seconds after application of beam voltage

Table 1-2. Capabilities and Limitations

Frequency	Operates at an assigned frequency in band of 755 to 985 mc
Input vswr	1.2:1
Output vswr	1.5:1
Power output (nominal)	10 kw
Power gain	30 to 33 db
Input impedance	50 ohms nominal
Output impedance	50 ohms nominal
Bandwidth	1 mc at 0.5 db, 6 mc at 3 db

Environmental Considerations

Ambient temperature:	
Operating	-29°C (-20°F) to +52°C (+126°F)
Nonoperating	-65°C (-85°F) to +71°C (+160°F)
Relative humidity	95 percent maximum
Barometric pressure:	
Operating	Sea level to approximately 10,000 ft
Nonoperating	Sea level to approximately 40,000 ft
Salt atmosphere	As encountered in coastal regions and during ocean transportation
Sand and dust	Particles as small as 0.0017 in. (as encountered in arid regions)

Table 1-3. Equipment Supplied

Official Nomenclature	Common Name	Mfr Part No.	Qty	Description	Component Designation	Usable On Code
Amplifier-Power Supply Group OA-2973/FRC-39A(V)	10-kw power amplifier	954	1		3	A
Amplifier-Power Supply Group OA-4408/MRC-98	10-kw power amplifier	954B	1		3	B
Cabinet, Electrical Equipment CY-2981/FRC-39A(V)	10-kw power amplifier cabinet	S1850	1	Houses the 10-kw power amplifier		A
Cabinet, Electrical Equipment CY-3794/MRC-98	10-kw power amplifier cabinet	S1850-3	1	Houses the 10-kw power amplifier		B
Amplifier, Radio Frequency AM-2752/FRC-39A(V)	Klystron carriage	S1851	1	Contains the klystron tube and associated circuitry	3A1	A
Amplifier, Radio Frequency AM-3629/MRC-98	Klystron carriage	S1851-2	1	Contains the klystron tube and associated circuitry	3A1	B
Panel, Power Distribution SB-1192/FRC-39A(V)	Distribution panel	S1852	1	Controls, distributes, and monitors klystron beam and bias supply voltages	3A2	A
Panel, Power Distribution SB-1847/MRC-98	Distribution panel	S1852-2	1	Controls, distributes, and monitors klystron beam and bias supply voltages	3A2	B
Panel, Power Distribution SB-1193/FRC-39A(V)	Ac control panel	S1854	1	Distributes and controls ac power to various circuits	3A3	
Control, Power Supply C-3396/FRC-39A(V)	120-volt regulator control panel	S1860	1	Controls and regulates voltages to various circuits	3A3A1	
Control, Power Supply C-3397/FRC-39A(V)	Field coils regulator control panel	S1860-1	1	Controls and regulates voltages to field coils power supply	3A3A2	
Power Supply PP-2744/FRC-39A(V)	Alarm power supply	S1857	1	Provides operating power for rf alarm relays	3A3A3	
Control, Power Supply C-3398/FRC-39A(V)	Beam regulator control panel	S1860-2	1	Voltage regulator for beam power supply	3A3A4	
Panel, Monitor SB-1194/FRC-39A(V)	Meter panel	S1855	1	Contains klystron operating voltage meters	3A4	
Control, Power Supply C-3395/FRC-39A(V)	Beam power primary control	S1856	1	Remotely controlled variable autotransformer and switches	3A5	A

Table 1-3. Equipment Supplied (cont)

Official Nomenclature	Common Name	Mfr Part No.	Qty	Description	Component Designation	Usable On Code
Control, Power Supply C-6126/URA-48	Beam power primary control	S1856-1	1	Remotely controlled variable autotransformers and switches	3A5	B
Transformer, Variable, Power TF-355/FRC-39A(V)	Field coils variable autotransformer	S1962	1	Remotely controlled variable autotransformer	3A6	
Power Supply PP2745/FRC-39A(V)	Focus coils power supply	S1858	1	Provides dc current for prefocus, field, and collector coils	3A7	

Table 1-4. Equipment Required but Not Supplied

Description	Model No.	Manufacturer	Qty
Test Equipment			
Bolometer, rf	MX-2144A/U		1
Filter press	7299ZR6799	General Electric	1
Gauge, pressure	U.S. No. 13296-1		1
Generator, signal	AN/URM-49( )		1
Multimeter	AN/PSM-6( )		1
Pump, vacuum			
Test Set, oil, portable	9T11Y8454	General Electric	1
Wattmeter, microwave power	TS-779/U		1
Common Tools			
Cleaning solvent			*
Crowbar			1
Drill bit, No. 30, 1/4 in.			1
Drill, electric, portable, 1/4 in. chuck			1
Gun, soldering, 100 watt			1
Hammer, ball peen			1
Hammer, claw			1
Knife, pocket			1
Lint-free cloths			*
Pliers, diagonal cutting, 6 in. long			1
Pliers, long round nose, 6 in. long			1
Screwdriver, cross tip no. 2			1
Screwdriver, cross tip no. 3			1
Screwdriver, offset, 3 in. long			1
Screwdriver, 7/32 in. flat tip, 6 in. long blade, plastic handle			1
Solvent-lubricant (Lubriplate, Fiske Bros. Refining Co. or equiv.)			*
Wrench, Allen, 1/16 in.			1
Wrench, pipe, 14 in. long adjustable jaw			1
Wrench, open end, adjustable 10 in. long			1
Wrench, open end, fixed, 1/4 in. and 3/16 in. size			1
Wrench, open end, fixed, 5/16 in. and 3/8 in. size			1
Wrench, open end, fixed, 5/8 in. and 9/16 in. size			1
Wrench, strap			2

*As required

CHAPTER 2
INSTALLATION

2-1. INTRODUCTION. Installation data for the 10-kw power amplifier is provided in this chapter. Section I discusses installation planning; Section II covers logistics, such as receiving data, material handling equipment, and cable requirements. The installation procedures, followed by appropriate references to post-installation testing procedures, are contained in Section III. Section IV discusses preparation of the equipment for reshipment.

SECTION I
INSTALLATION PLANNING

2-2. REFERENCE DATA.

2-3. The following publication is applicable:

TM 11-2262-6, Outside Plant Construction and Maintenance:

Building Cable Construction and Maintenance.

2-4. For general information regarding equipment interrelationships, antenna and transmission line requirements, grounding and lightning protection, and ancillary facilities, refer to the detailed site plans. For leading particulars, refer to table 1-1 of Chapter 1.

2-5. AC POWER REQUIREMENTS.

2-6. The ac power requirements for the 10-kw power amplifier are shown in table 1-1 of Chapter 1.

SECTION II
LOGISTICS

2-7. RECEIVING DATA.

2-8. Table 2-1 lists all of the supplied equipment. The table includes the following shipping data: crate numbers, contents of each crate and the quantity, crated and uncrated dimensions, crated volume, and gross weight of each component. Preservation and packing of each component is in accordance with MIL-P-116D. Marking of each component is in accordance with MIL-STD-129C.

2-9. TRANSPORTABILITY AND MATERIAL HANDLING.

2-10. All units comprising the 10-kw power amplifier are designed for convenient transportation. Overall dimensions allow airlift by C-119 aircraft or H-21 helicopter. A 2-1/2-ton truck is suitable for ground transport. A 1-1/2-ton capacity chain hoist, or a forklift truck should be used for lifting some of the heavy or bulky items listed in table 2-1.

Table 2-1. Shipping Data

Crate No.	Contents	Qty	Crated					Uncrated		
			Dimensions (in.)			Volume (cu ft)	Weight (lbs)	Dimensions (in.)		
			Height	Width	Depth			Height	Width	Depth
1	Power section cabinet less: Capacitors 3C3 and 3C4 Autotransformers 3T2 and 3T3 Beam power transformer 3T4 Rectifiers 3CR1 through 3CR6	1	82	55	59	153.1	1485	72	45.5	48
2	Amplifier section cabinet: Transmission line Bias control panel Air socket and air duct assembly Drive shafts Copper tubing Capacitors 3C3 and 3C4 Field coils variable auto-transformer 3A6	1 1 set 1 1 1 set 1 set 1 1	83	47	59	133.2	1065	72	38.5	48
3	Klystron carriage 3A1 less: Klystron tube 3A1V1, 4KM50000LR Air socket and air duct assembly Cavities 3A1Z1 through 3A1Z4 Drive shafts Transmission line Coils 3A1L2 through 3A1L5	1	73	55	47	109.2	1075	62	38	41
4	Klystron tube 3A1V1, 4KM50000LR	1	65	20	19	15.9	192			
5	Beam power transformer 3T4	1	61	46	32	52	2650			
6	Autotransformers 3T2 and 3T3	1 each	45	26	22	14.4	1080			
7	Items: Body coils 3A1L2 through 3A1L4 Collector coil 3A1L5 Rectifiers 3CR1 through 3CR6 Cavities 3A1Z1 through 3A1Z4	 1 each 1 1 each 1 each	29	27	38	17.2	660			

Other specific handling equipment used depends upon what is available at a particular site, and must be determined by the installer.

2-11. CABLE REQUIREMENTS.

2-12. Table 2-2 lists all of the interconnecting cables required in installing the 10-kw power amplifier.

2-13. UNPACKING AND UNIT IDENTIFICATION.

2-14. Components of the 10-kw power amplifier are packed in crates lined with greaseproof and waterproof material. Each crate contains the necessary bracing and padding to fit the component it is to hold.

2-15. The 10-kw power amplifier has been partially disassembled and the various components packed separately for shipment. Before uncrating the equipment, place the crates as close as possible to the planned installation position. Exercise care when uncrating the equipment. Retain the original container and the special packing for the klystron tube. This is necessary in the event the klystron tube is reshipped.

2-16. Refer to the shipping data in table 2-1 to identify the contents of each crate. Inspect each component for physical damage. If the equipment is damaged in any way, save all the packing material including the shipping crate, to substantiate claims against the transporting agency.

2-17. Test data cards are shipped with the klystron tubes and must be retained for ready reference during maintenance and adjustment.

Table 2-2. Cable Requirements

Function	Cable Type	From-	To-
208 V, 60 cps, 3 phase power input	4-No. 0 gauge wires	Station power	Terminal board 3TB1, terminals 1, 2, 3 and 4; neutral line to terminal 4
120 V, 60 cps single phase power input	2-No. 8 gauge wires	Station power	Terminal board 3TB2, terminals 1 and 2; neutral line to terminal 2
Heat exchanger control wiring	3-No. 16 gauge wires	Terminal board 3TB4, terminals 1 and 2 and 4	Heat exchanger
RF power input	RG-254/U	Exciter	RF INPUT connector 3J5
RF power output	3-1/8 in. rigid coax	RF output connector	Diplexer, antenna, or dummy load
Cabinet temperature alarm	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 2 and 3	Station alarm facility
Alarm power supply failure	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 5 and 6	Station alarm facility
High vswr alarm	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 8 and 9	Station alarm facility
Low forward power alarm	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 11 and 12	Station alarm facility
Recycle indication	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 14 and 15	Station alarm facility
Filament changeover indication	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 17 and 18	Station alarm facility
120 V regulator alarm	No. 22 gauge shielded pair	Terminal board 3TB3, terminals 19 and 20	Station alarm facility

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SECTION III
INSTALLATION PROCEDURES

2-18. INSTALLATION TOOLS AND TEST EQUIPMENT.

2-19. All installation procedures can be performed by using standard tools available at the installation site. These installation tools are listed in table 1-4.

2-20. No test equipment is required for the installation of the 10-kw power amplifier; however, test equipment is required for postinstallation adjustment and alignment, and is listed in table 1-4.

2-21. INSTALLATION AND ASSEMBLY OF THE 10-KW POWER AMPLIFIER.

2-22. GENERAL.

2-23. Because of the large size and weight of the 10-kw power amplifier components, a minimum of two men is required for proper installation. Refer to the applicable group assembly parts list in TM 11-5820-757-25P for description and location of screws, nuts, washers, and miscellaneous mounting hardware used in the assembly of the 10-kw power amplifier.

2-24. The 10-kw power amplifier is comprised of two sections: the power section on the left and the amplifier section on the right. Complete installation of the 10-kw power amplifier is accomplished through the front of the equipment, however, if space will permit, the side and rear cover panels may be removed to facilitate installation. While assembling the 10-kw power amplifier, make constant reference to the illustrations incorporated in this manual. All references to component locations are made viewing the equipment from the front. To install and assemble the 10-kw power amplifier, perform, in proper sequence, the procedures outlined in paragraphs 2-25 through 2-48.

2-25. INSTALLATION AND ASSEMBLY OF THE POWER SECTION.

2-26. Install the power section as follows:

a. Position the power section to the desired location in accordance with figure 2-1 and the detailed site plans.

b. Bolt the power section securely to the floor, through the four sleeve bushings in the base of the power section, using 3/8-16 bolts, 3 inches long.

2-27. INSTALLATION OF BEAM POWER RECTIFIERS 3CR1 THROUGH 3CR6. To install the beam power rectifiers, refer to figure 2-2 and proceed as follows:

a. Loosen two knurled knobs on ac control panel 3A3 and swing the panel open to its limit.

b. Loosen the knurled knobs on the two rectifier support assemblies and pull them out to their limits.

c. Loosen three knurled knobs on the upper rack rectifier support bracket and remove it.

d. Loosen three knurled knobs on the lower rack rectifier support bracket and remove it.

e. Lift each of six rectifiers by the handle and place each in the rack, handle up. Connect ground braid between GRD 1 and common terminals on 3CR1 through 3CR3, and between GRD 3 and common terminals on 3CR4 through 3CR6. Install the upper and lower rectifier support assembly bracket, and tighten the knurled knobs.

f. Release the catches on each side of the sliding rails, push the rectifier support assemblies closed, and tighten the knurled knobs.

g. Connect the following harness leads between the associated terminals:

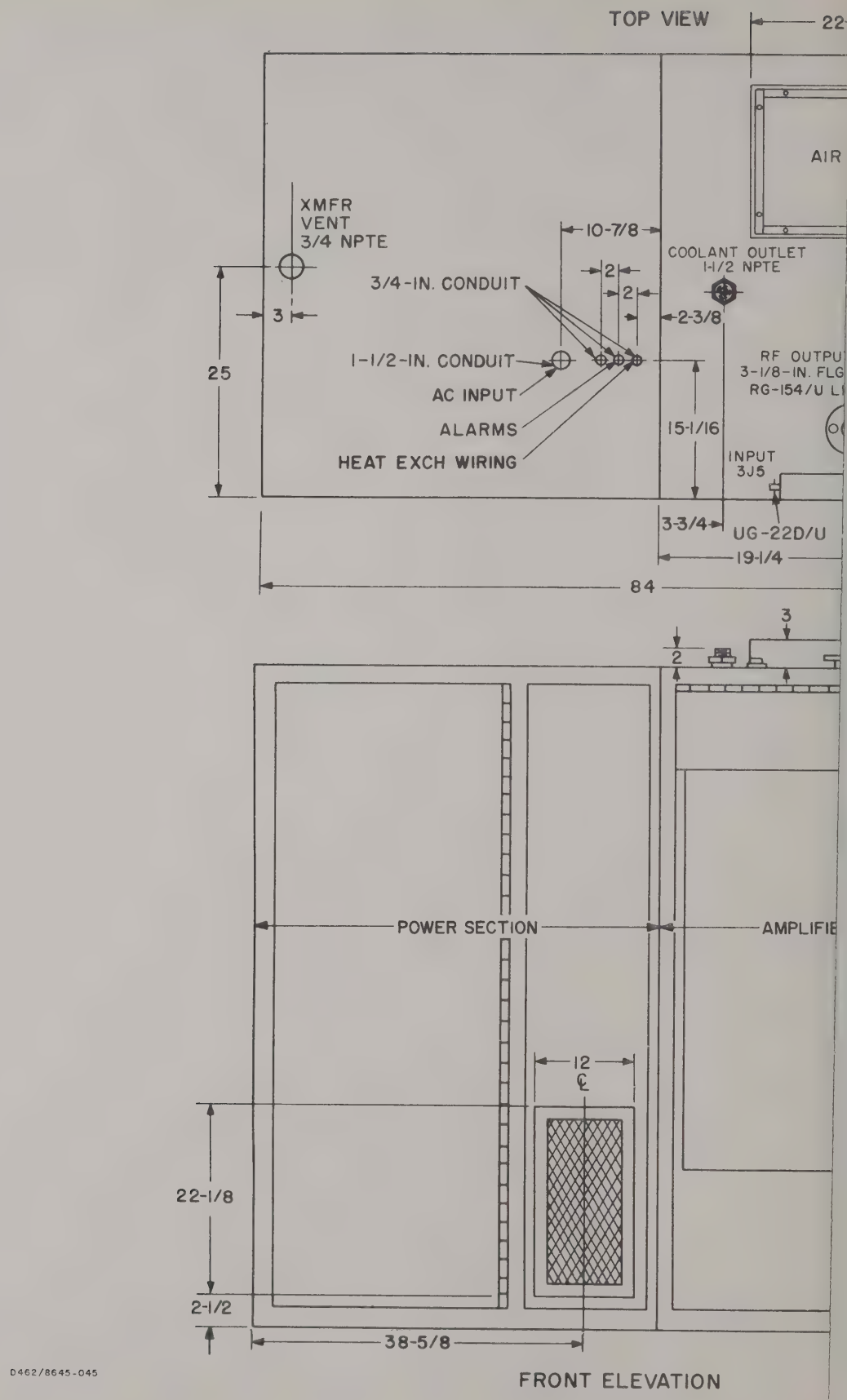

Figure 2-1. 10-KW Power Amplifier Installation Diagram

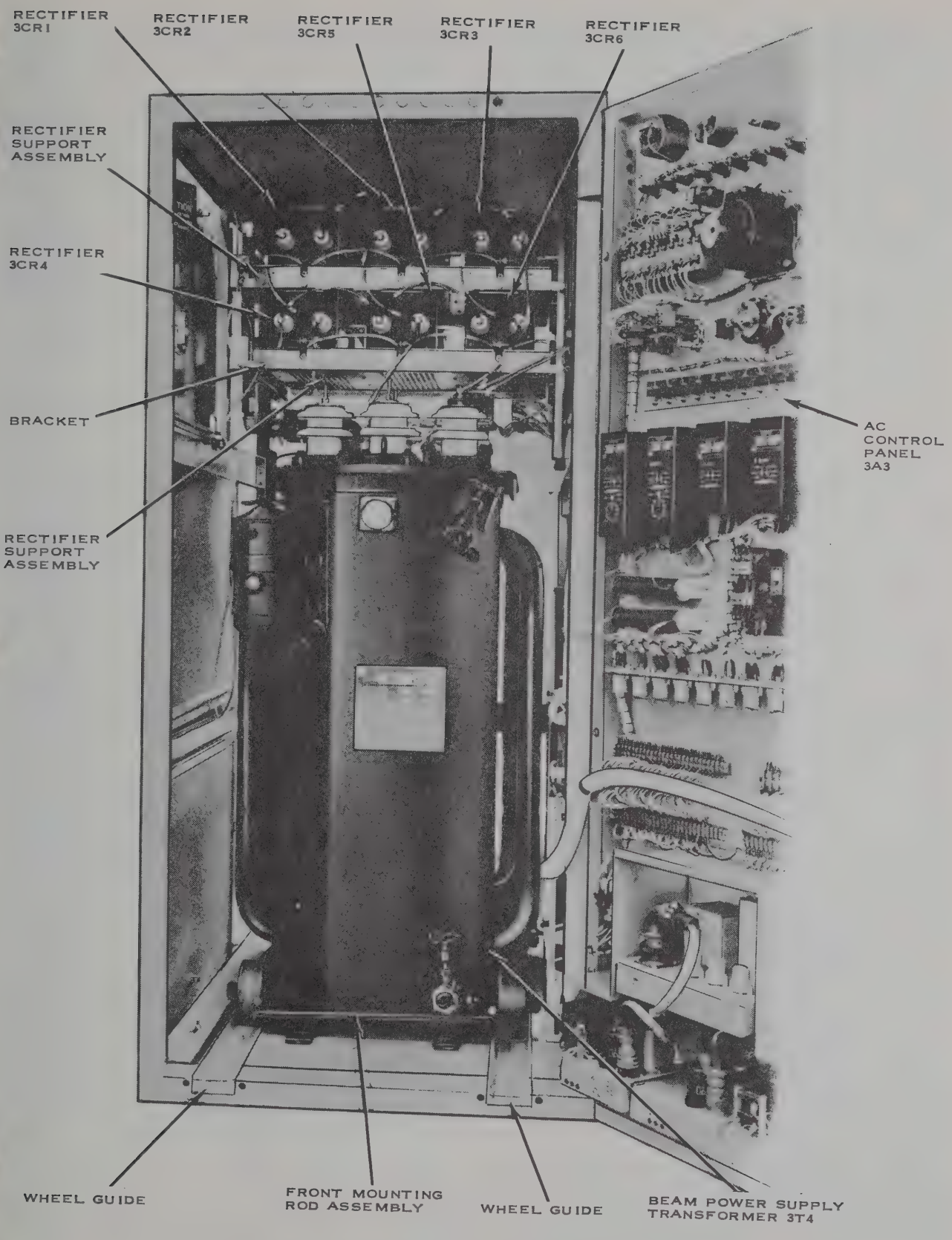

Figure 2-2. 10-KW Power Amplifier Cabinet Power Section

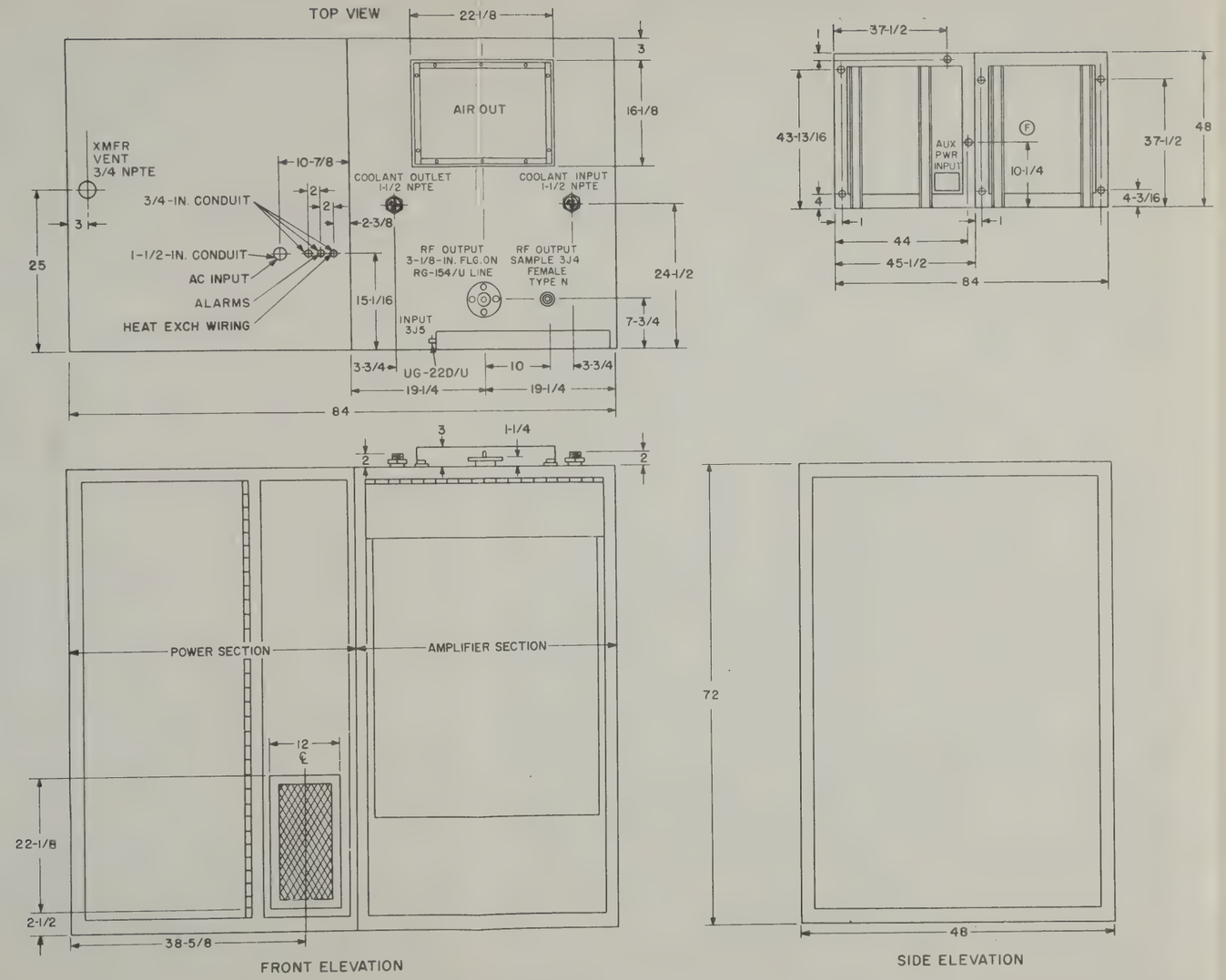

Figure 2-1. 10-KW Power Amplifier Installation Diagram

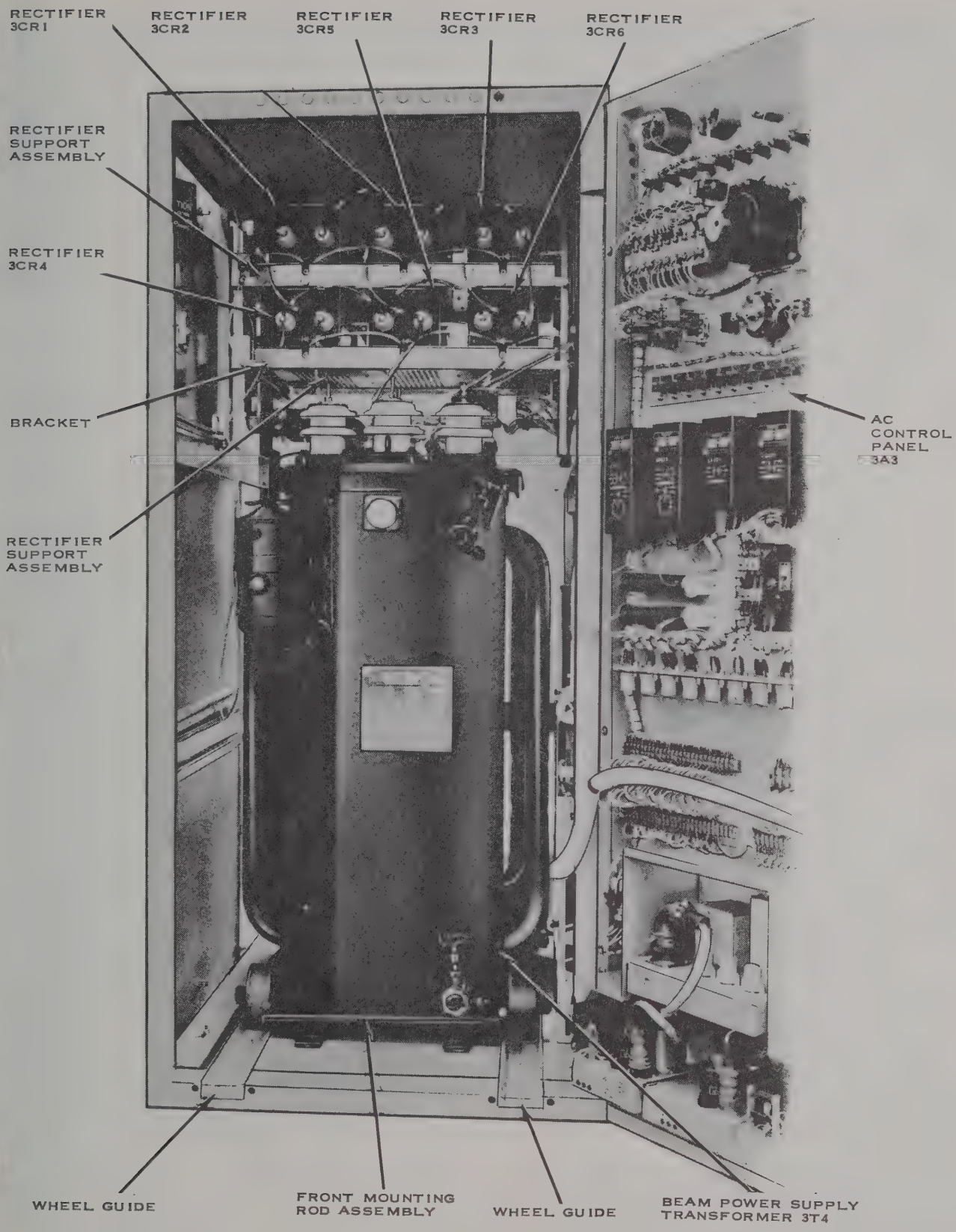

Figure 2-2. 10-KW Power Amplifier Cabinet Power Section

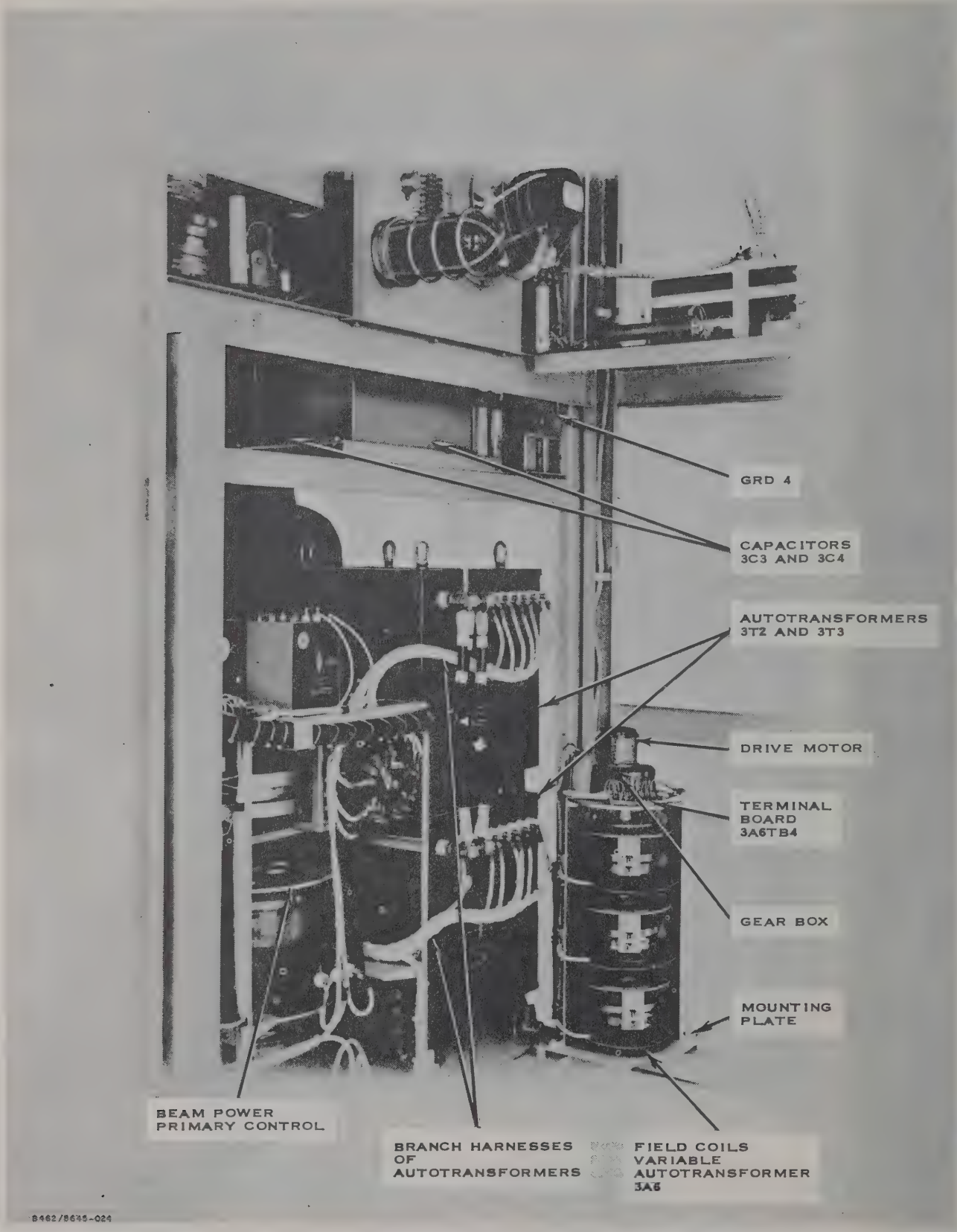

Figure 2-3. 10-KW Power Amplifier, Interior View

a. Place two ramps in front of the power section wheel guides and clear away any obstruction in front to the beam power supply transformer.

b. Position the beam power supply transformer carefully so that it will roll forward in a straight line, and station a man on each side to assist in guiding it.

CAUTION

Damage may occur to the beam power supply transformer if it is not positioned properly before rolling it into the bay. Due to its weight (one ton) once set in motion it is difficult to change its direction.

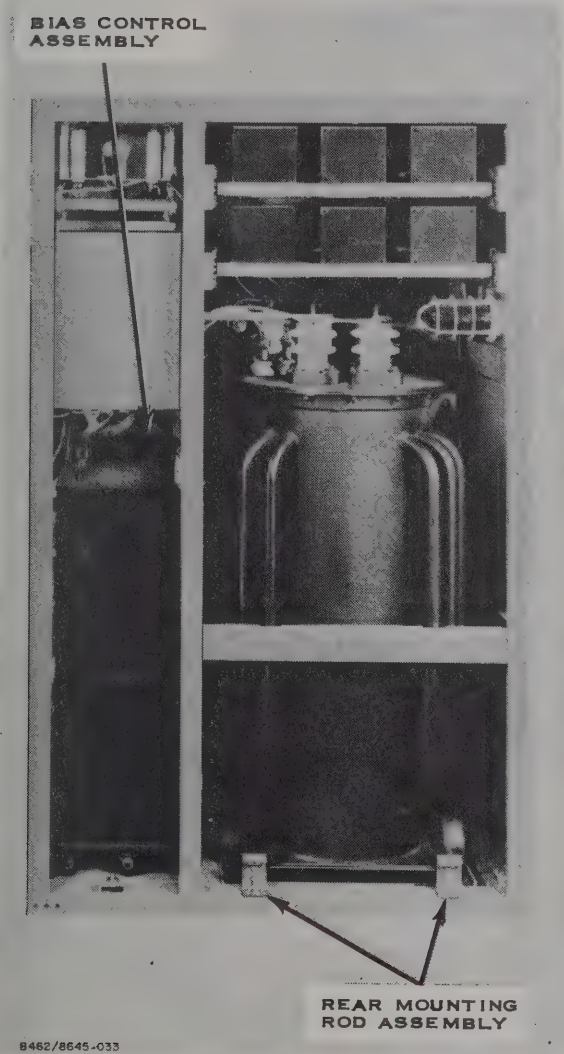

Figure 2-4. Power Section, Rear View

c. Roll the beam power supply transformer into the bay and secure it in place with the front and rear mounting rod assemblies provided. Insert two bolts into each mounting rod assembly and tighten the bolts.

d. Connect the following color-coded harness leads to the associated terminals of the beam power supply transformer:

Harness Wire	To Terminal on Beam Power Supply Transformer
white/gray/black	X1
white/gray	X2
white/gray/red	X3
white/black	1
white/black	1
white/black/gray	2
white/gray/yellow (3W21)	3
white/gray/black (3W22)	4
white/gray/violet	5
white/gray/red	6
pink 3R6 (3W18)	7
pink (-) 3CR3 (3W13)	8
pink (-) 3C3 (3W19)	8
green (-) 3CR4 (3W15)	H1
green (-) 3CR6 (3W17)	H2
green (-) 3CR5 (3W12)	H3

e. Connect the ground braid from GRD 5 to GRD 6 (fig. 2-6) at the bottom of the cabinet.

2-32. INSTALLATION AND ASSEMBLY OF THE AMPLIFIER SECTION.

2-33. Install the amplifier section as follows:

a. Position the amplifier section to the desired location in accordance with figure 2-1.

b. Bolt the amplifier section securely to the floor adjacent to the power section.

c. Bolt the amplifier and the power sections together with the existing hardware.

2-34. INSTALLATION OF FIELD COILS VARIABLE AUTOTRANSFORMER 3A6. To install the field coils variable autotransformer, refer to figure 2-3 and proceed as follows:

a. Place the field coils variable autotransformer on the mounting plate and secure it with bolts and nuts.

b. Connect the following color-coded harness leads to the associated terminals on terminal board 3A6TB4:

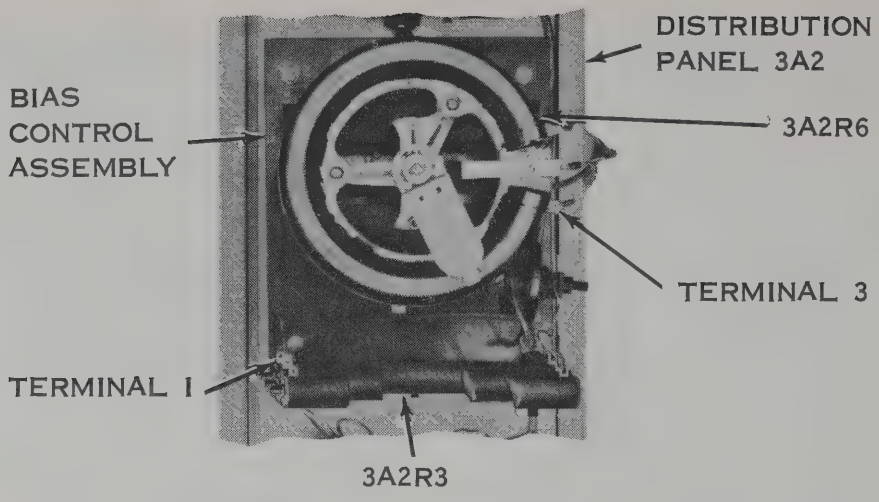

Figure 2-5. Bias Control Assembly

Harness Wire	To Terminal on 3A6TB4
white/gray/yellow	1
white/gray/violet	2
white/gray/blue	3
white/gray/red	4
white/gray/orange	5
white/gray/brown	6
white/gray/green	7
white/gray/red	8
white/black	9

2-35. CABINET WIRING AND EXTERNAL CONNECTIONS. Perform the following wiring and strapping procedures in accordance with the 10-kw power amplifier schematic wiring diagram in chapter 6 of this manual and figure 2-6.

a. Connect the following color-coded harness leads to the associated terminals on terminal board 3TB8:

NOTE

These harness wires may have been factory connected.

Harness Wire	To Terminal on 3TB8
white/red	1
white/red	1
white/red/black	2
white/red/red	3
white/gray	4
white/gray/black	5
white/gray/brown	6
white/red	7
white/red/black	8
white/red/brown	9
white/red/red	10
white/white	11
white/white/black	12
white/black/red	13
white/gray/blue	14
white/gray/black	15
white/gray/brown	16
white/gray/red	17
white/gray/orange	18
white/gray	19
white/gray/red	20
white/gray/orange	21
white/violet	22
white/gray/yellow	23
white/black	24
white/black	24

b. Connect the following color-coded harness leads to the associated terminals on terminal board 3TB9:

NOTE

These harness wires may have been factory connected.

Harness Wire	To Terminal on 3TB9
white/gray/orange	1
white/violet/black	2
white/gray/green	3

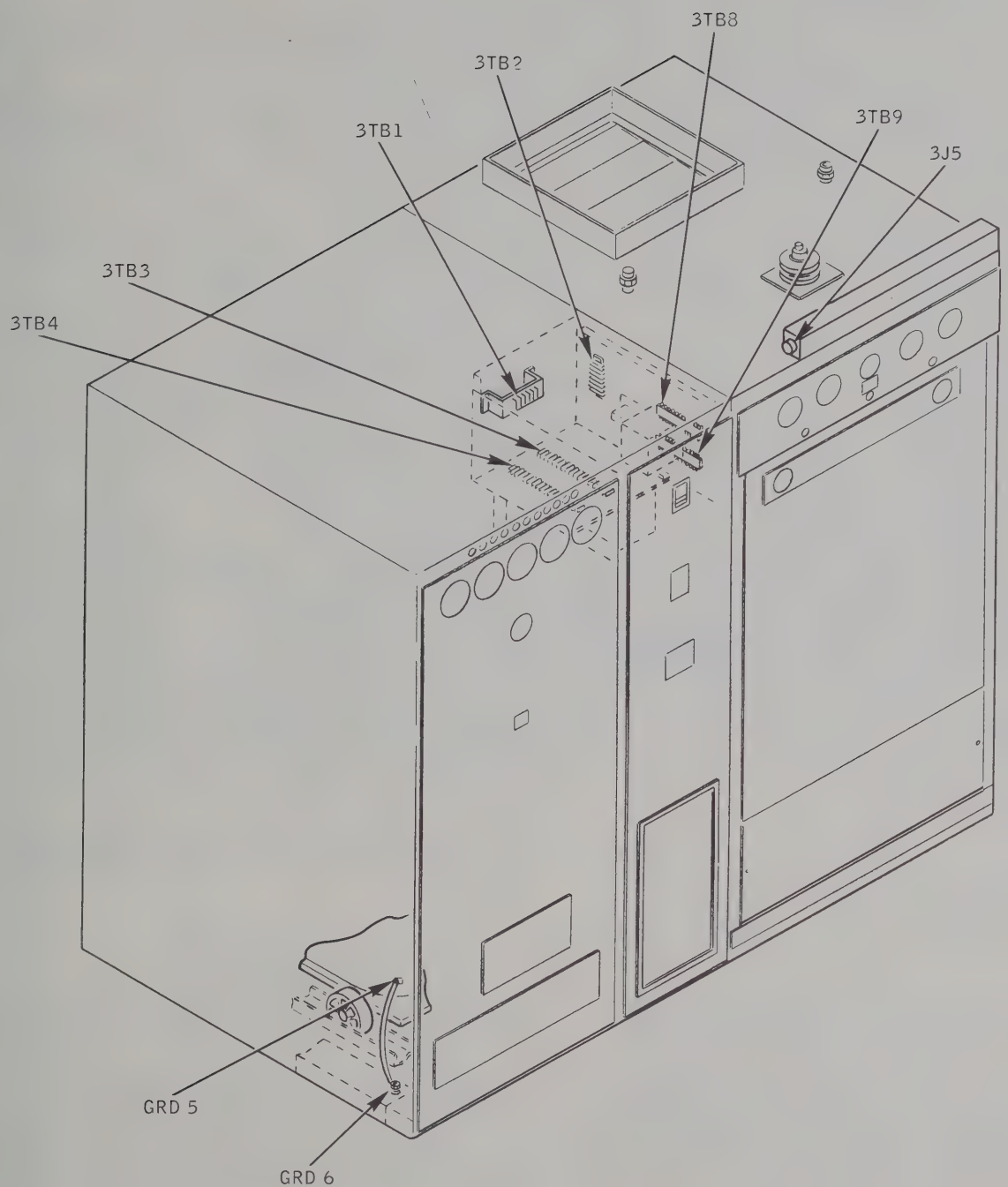

Figure 2-6. Cabinet Wiring

Harness Wire (cont)	To Terminal on 3TB9
white/gray/red	4
white/gray/brown	5
white/gray	6
white/gray/yellow	7
white/gray/red	8
white/gray/orange	9
white/gray/brown	10
white/violet/gray	11
white/gray/violet	12
white/gray/brown	13
not used	15-22
white/black	23, 24 (strapped together)

c. Connect straps between terminals 2 and 3, 5 and 6, 8 and 15, 9 and 11, and 10 and 12 of terminal board 3TB4.

d. Make the connections to and from the 10-kw power amplifier in accordance with table 2-2 and figures 2-1 and 2-6.

NOTE

All references to location in the following procedure are made viewing the klystron carriage from the front.

2-36. ASSEMBLY OF KLYSTRON CARRIAGE.

2-37. INSTALLATION OF THE COLLECTOR COIL AND BODY COILS. Install the collector coil and body coils as follows:

a. Disconnect the prefocus coil positioning coupling shafts (fig. 2-7) at the quick-disconnect fittings behind the klystron carriage front panel.

b. Remove the prefocus coil assembly from the magnetic frame top cover as follows:

(1) Release the two tension springs installed between the front corner posts and the knurled nuts at the rear of the prefocus coil assembly.

(2) Remove the thumbscrews and large aluminum washers from the four corner posts.

(3) Remove the eight knurled nuts holding the magnetic shield to the top plate of the prefocus coil assembly.

(4) Remove the two halves of the top plate, the prefocus coil, the two halves of the magnetic shield, and the neck supporting plates.

c. Install the collector ring over the hole in the bottom plate of the magnetic frame (fig. 2-8).

d. Remove the eight screws holding the magnetic frame top cover with the Allen T-wrench mounted on the side of the magnetic frame and remove the top cover.

e. Loosen the locking screws and swing the body coil supporting blocks flat against the vertical members of the magnetic frame.

f. Install collector coil MC-230 (3L5) over the collector ring with terminals facing to the right side of the klystron carriage.

g. Install the three body coils with the terminals facing to the right side of the klystron carriage, in the following order:

Body Coil	Designation
Y-234	3rd Body Coil 3L4
MC-229	2nd Body Coil 3L3
MC-228	1st Body Coil 3L2

h. Replace the top cover on the magnetic frame, making sure that the access hole on the cover is lined up with the access hole on the cross member, and secure with the eight holding screws.

2-38. INSTALLATION OF KLYSTRON TUBE. To install the klystron tube, proceed as follows:

CAUTION

Exercise care when handling the klystron tube. Be careful not to damage the connector rings or subject the tube to rough handling. Avoid hitting or scraping the metal strap marked DO NOT BUMP. If this strap is damaged, the getter and collector circuits could be shorted.

a. Remove the plastic protective cover, the paper wraps from the ceramic windows (fig. 2-9), the brass nuts and plastic caps from the body and collector coolant fittings, and inspect the klystron tube for visible damage.

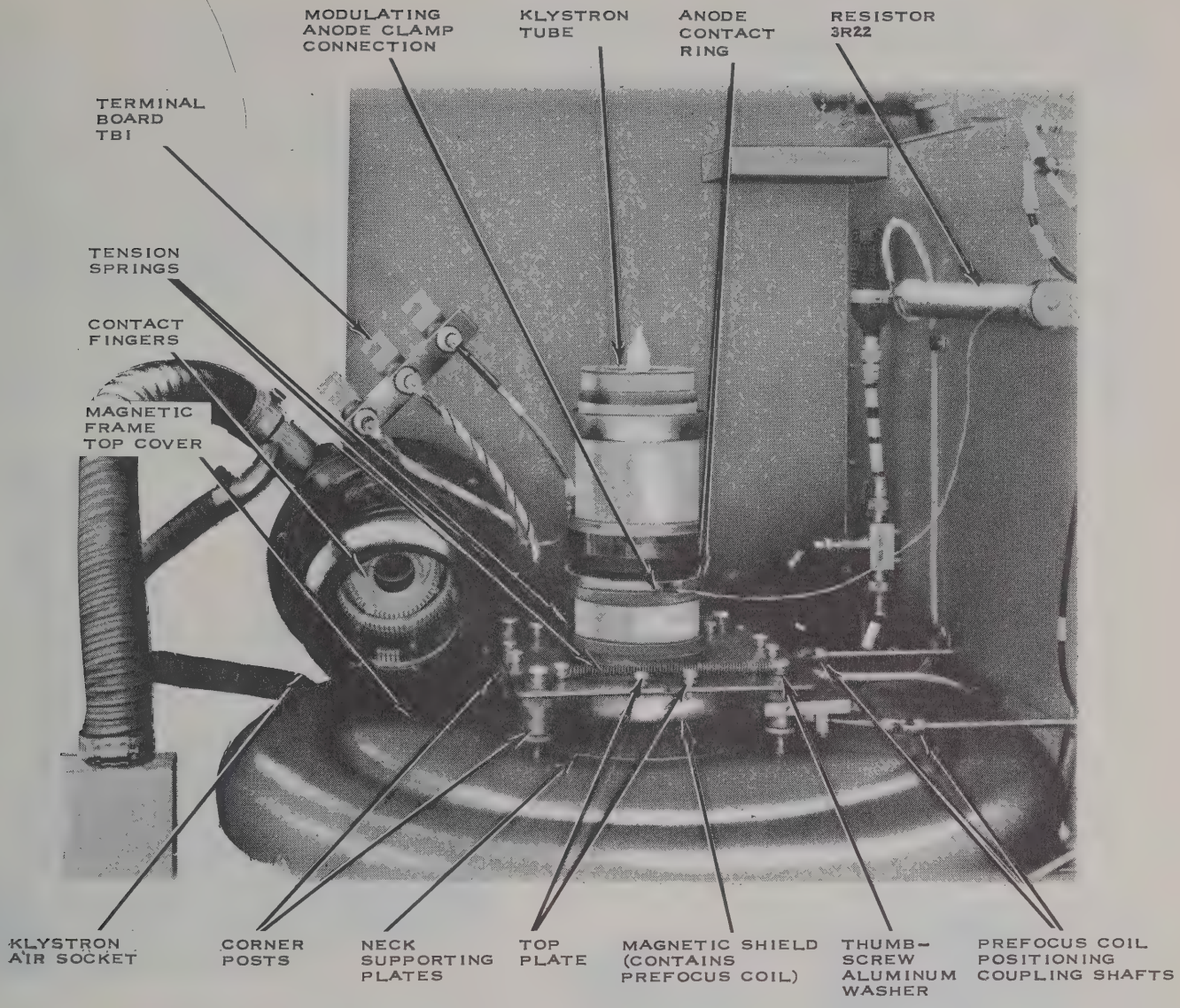

Figure 2-7. Prefocus Coil Assembly

b. Prepare a raised platform on the left side of the klystron carriage and position an assistant on it.

c. Grasp the klystron tube by the neck and below the mounting flange and lift it from the crate.

d. Carry the tube horizontally to the klystron carriage and transfer it to the assistant standing on the platform.

e. Working from the platform, turn the tube upright and carefully rest the collector section on the top of the magnetic frame.

f. With both hands, grasp the tube by the neck and, while the assistant guides the collector section through the collector ring (fig. 2-8) at the bottom of the magnetic frame, lower the tube until the mounting flange (fig. 2-9) is seated squarely on the collector ring.

g. Raise the tube slightly and carefully rotate it until the body coolant fittings are facing to the left side of the klystron carriage.

h. Insert the two halves of the neck supporting plates (fig. 2-7) in the top opening of the magnetic frame.

i. Check the collector section of the tube to insure that the mounting screws on the upper end of the getter strap (fig. 2-9) are not touching the inside walls of the collector ring.

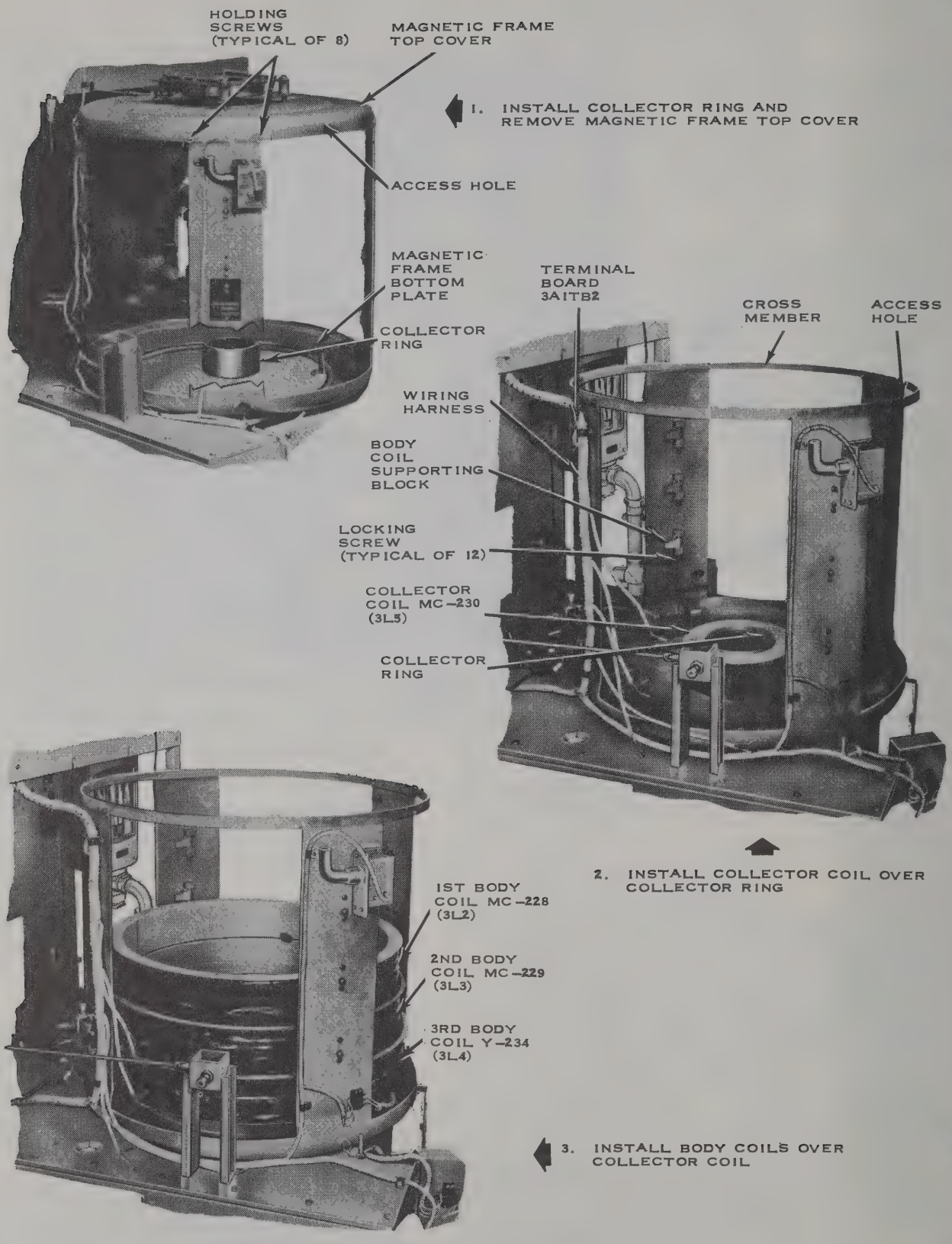

Figure 2-8. Collector and Body Coils Installation

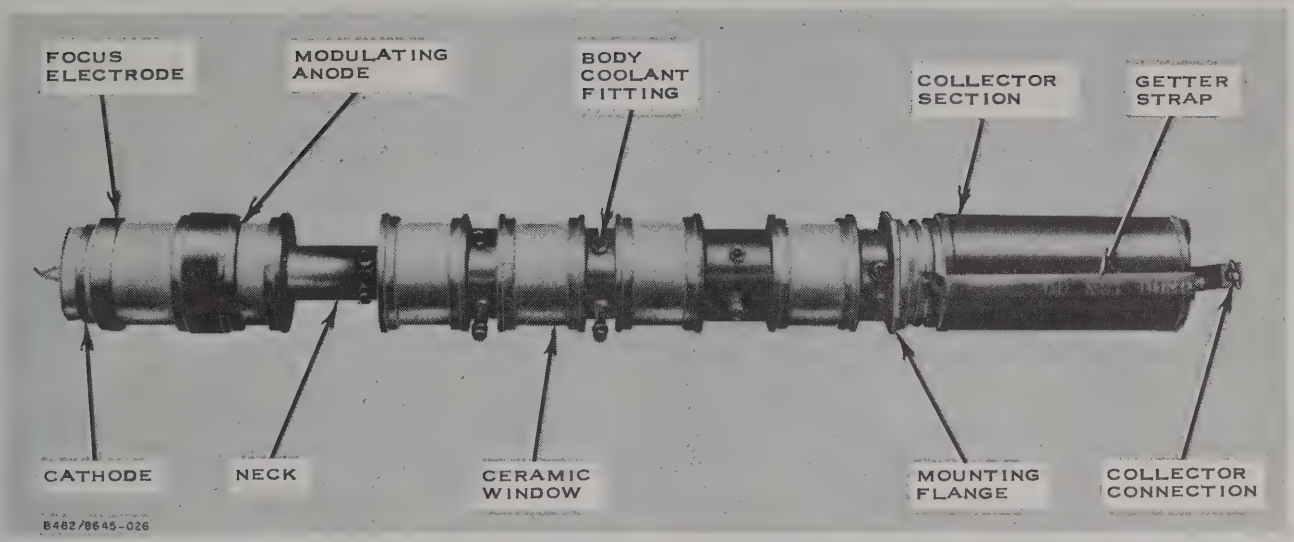

Figure 2-9. Klystron Tube

CAUTION

Do not exert undue pressure when securing the modulating anode clamp to modulating anode contact ring. To do so could damage the klystron tube.

j. Slip the anode contact ring over the top of the klystron tube and secure it to the modulating anode. Connect the white/red wire from resistor 3R22 (fig. 2-7) to the modulating anode clamp connection and tighten the clamping screw.

2-39. INSTALLATION OF THE COOLANT LINES. Before connecting the coolant lines to the klystron tube coolant fittings, insure that the coolant lines are free of foreign matter and that the locknuts on each coolant line are equipped with rubber gaskets.

CAUTION

Do not rock or move the klystron tube while the neck supporting plates are removed. To do so could cause damage to the klystron tube.

a. Remove one neck supporting plate (fig. 2-7) to facilitate installation of the first two coolant lines.

NOTE

After installing the first two coolant lines, replace the neck supporting plate before continuing to install the remaining coolant lines.

b. Install the color-coded coolant lines between the drift tube sections of the klystron tube from top to bottom, in accordance with figure 2-10, as follows:

(1) Insert the 5/16-inch copper tubing coolant line into the fitting on the body of the klystron tube.

(2) Thread the locknut over the fitting and carefully tighten the locknut using a 5/8-inch open end wrench.

c. Open the hinged klystron blower panel at the rear of the klystron carriage for access to the collector section of the klystron tube.

d. Slip a rubber gasket into the 1-1/4-inch nuts and insert the collector flow coolant lines into the corresponding fittings at the bottom of the klystron tube collector.

e. Thread the locknuts over the fittings and carefully tighten the locknuts using a 1-1/4-inch wrench.

f. Connect the white/red/red wire leading from the harness near the klystron tube col-

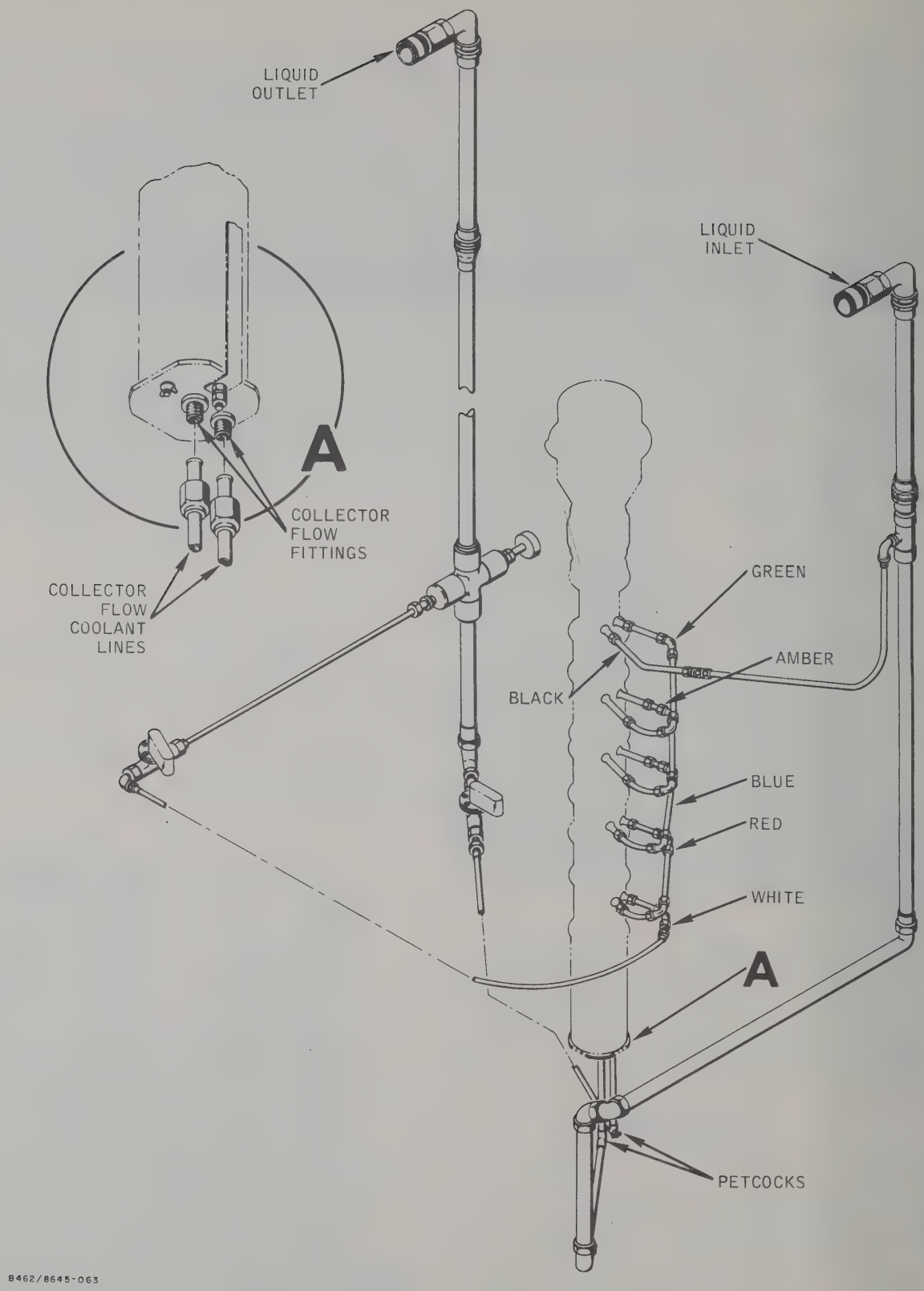

Figure 2-10. Coolant Lines Installation

lector section to the collector connection (fig. 2-9) of the klystron tube.

g. Connect the white/gray wire leading from terminal 5 of transformer 3T2 located on the right-rear frame of the klystron carriage near the klystron blower to the collector connection of the klystron tube. Tighten the wing nut.

h. Connect the white/gray/black wire leading from terminal 4 of transformer 3T2 to the stud at the bottom of the getter strap.

i. Check that the getter strap is not shorted to the body of the tube and that the getter strap mounting screws are not touching the inside walls of the collector ring. Close and secure the hinged klystron blower panel.

2-40. INSTALLATION OF THE PREFOCUS COIL ASSEMBLY. Refer to figure 2-7 and install the prefocus coil assembly as follows:

CAUTION

Do not rock or move the klystron tube while the neck supporting plates are removed. To do so could cause damage to the klystron tube.

a. Remove the neck supporting plates from the neck of the klystron tube.

b. Place the two halves of the magnetic shield with the open side up, on the top of the magnetic frame; one on the left side of the klystron tube and the other on the right side.

c. Slip prefocus coil 3L1, with the side marked TOP up and the two leads facing to the right, over the end of the klystron tube and onto the magnetic shield halves.

d. Place the two halves of the prefocus coil assembly top plate, with the notched side facing to the right, over the magnetic shield and the prefocus coil.

e. Guide the two leads of the prefocus coil through the notch on the right side of the top plate.

f. Attach the right half of the magnetic shield to the two top plate halves and secure with four knurled nuts.

g. Attach the left half of the magnetic shield to the two top plate halves and secure with four knurled nuts.

h. Place the assembly onto the four corner posts and fit the large aluminum washers over the mounting holes of the top plate. Secure the assembly with four knurled nuts, leaving enough clearance to allow the assembly to move freely in any horizontal direction.

i. Replace the neck supporting plates around the neck of the klystron tube.

j. Adjust the level of the prefocus coil assembly for an all-around clearance of 1/16 inch between the top plate and the klystron tube as follows:

(1) Back off the locknut from the movable corner post.

(2) Adjust the movable corner post up or down until the desired clearance is obtained.

(3) Repeat steps (1) and (2) at all corner posts until the desired all-around clearance (1/16 inch) is obtained.

k. Install the two tension springs between the front corner posts and the knurled nuts at the rear of the prefocus coil assembly.

l. Connect the wire with the green sleeving from prefocus coil 3L1 to the upper terminal of terminal board 3A1TB2 (fig. 2-8), and the wire with the yellow sleeving from the same coil to the lower terminal.

2-41. INSTALLATION OF THE KLYSTRON CAVITIES. To facilitate installation of the klystron cavities, the two access plates on the front panel of the klystron carriage may be removed. The aid of an assistant will be required to install the cavities on the klystron tube.

a. Remove the four Allen-head screws from first klystron cavity 3Z1 (fig. 2-11) and open the snap fasteners to separate the two cavity halves. Remove the coupling drive connecting shaft.

b. Apply Lubriplate with a clean, lint-free cloth to the inside of the cavity. Wipe the cavity as dry as possible, using another dry, lint-free cloth. If extremely dirty, use a good grade of commercial solvent to clean the cavity before applying the Lubriplate.

c. Determine the operating frequency for your equipment. If the assigned frequency is below 870 mc the position of the load loop (fig. 2-11) should be 60 degrees (fig. 2-12). If the

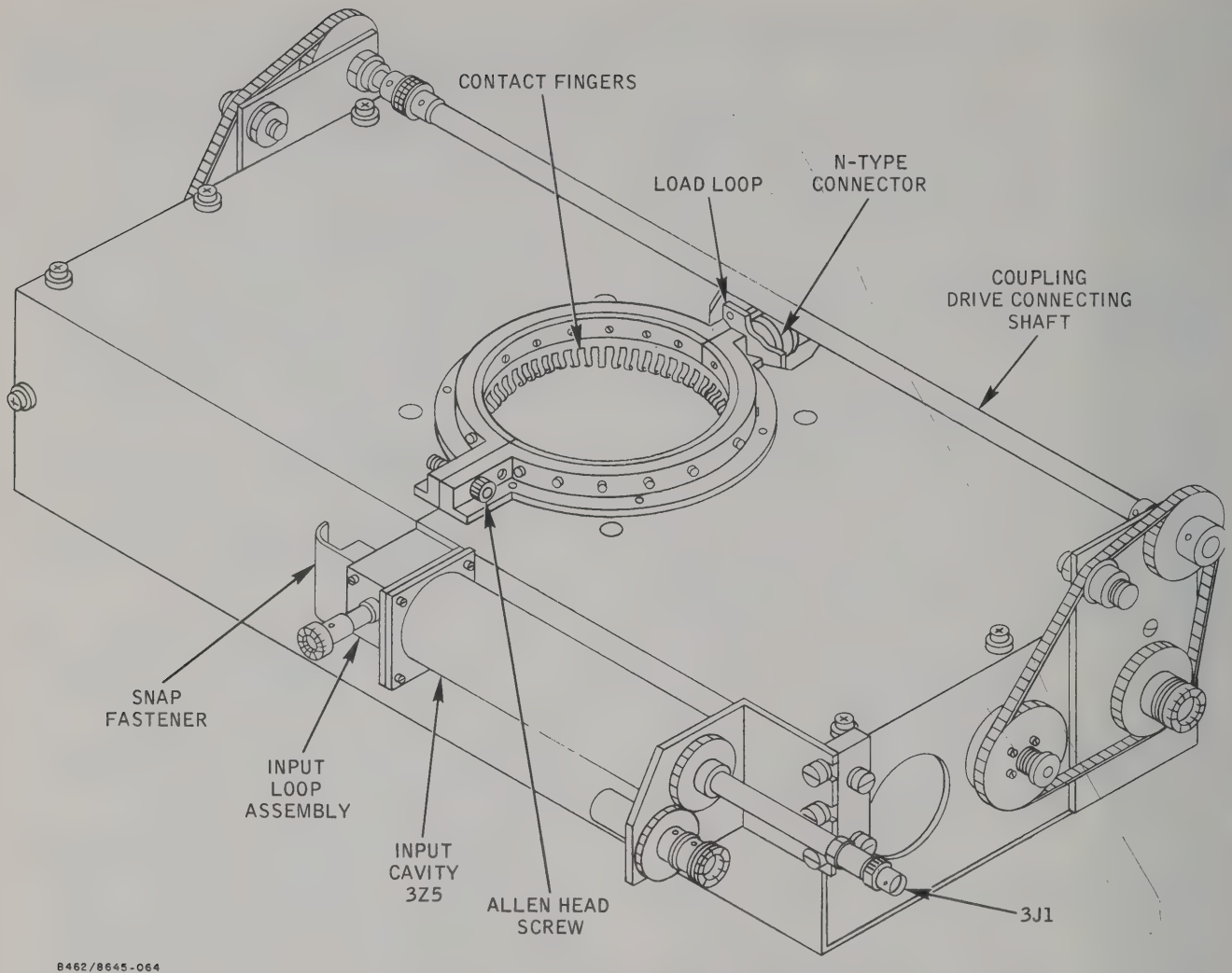

Figure 2-11. First Klystron Cavity 3Z1

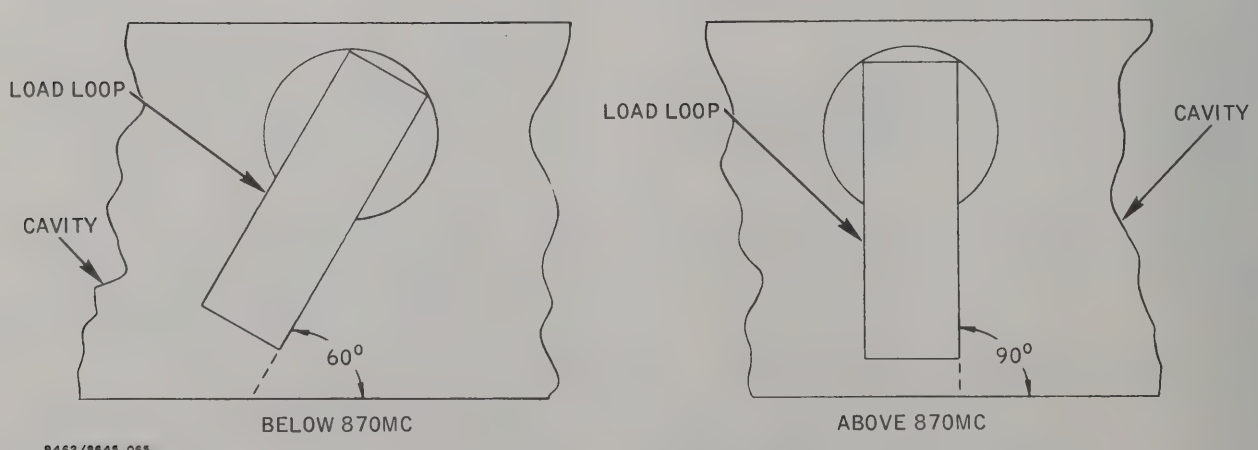

Figure 2-12. Load Loop Angle

assigned frequency is above 870 mc the position of the load loop should be 90 degrees. If the position of the load loop is not correct, loosen the four screws on the N-type connector plate and rotate the connector until the load is in the desired position. Tighten the screws.

d. Remove the input cavity (fig. 2-11) by removing its mounting hardware. Look into the input loop assembly and check that the proper input loop for your operating frequency (as shown in fig. 2-13) has been supplied.

e. Replace the input cavity.

f. Synchronize the two halves of the cavity by rotating the coupling drive connecting shaft on each cavity half until the coupling doors are at the maximum closed (maximum coupling) position in respect to the klystron tube.

g. Set the half of the first cavity with the input cavity mounted on the side onto the metal contact rings of the ceramic windown (fig. 2-9) nearest the top of the klystron tube. Rotate the cavity half until the input cavity is on the left-front side of the klystron carriage.

CAUTION

Exercise extreme care when aligning the two halves of the cavities to prevent damaging the delicate contact fingers.

h. Hold the cavity half in place while the assistant installs the other cavity half, carefully aligning the contact fingers (fig. 2-11).

i. Insure that the coupling drive connecting shaft is meshed, then close the two snap fasteners.

j. Replace the four Allen-head screws using the T-wrench mounted on the magnetic frame. The T-wrench is inserted through the front and rear access holes on the magnetic frame to tighten the top two screws.

k. Repeat steps a, b, and c for the second cavity.

l. Set either half of the cavity onto the metal contact rings of the second cavity ceramic window (fig. 2-9) with the snap fastener on the right side of the klystron carriage.

m. Repeat steps h and i for the second cavity.

n. Replace the four Allen-head screws using the T-wrench.

o. With the aid of the assistant, carefully raise first body coil 3L2 (fig. 2-8).

p. Swing the four supporting blocks under the first body coil and set the coil on lowest notch of the brackets.

q. Tighten the four locking screws and check that the blocks are held firmly in place.

r. Center the coil around the klystron tube and check that the terminals are on the right side of the klystron carriage.

s. Repeat steps a, b, and f for the third cavity.

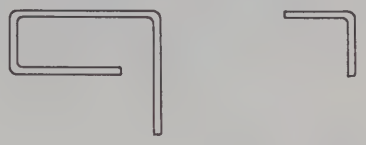

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Figure 2-13. Input Loops

t. Set either half of the cavity onto the metal contact rings of the third cavity ceramic window (fig. 2-9) with the load loop on the right side.

u. Repeat steps h, i, and n for the third cavity.

v. With aid of the assistant, carefully raise second body coil 3L3 (fig. 2-8).

w. Swing the four supporting blocks under the second body coil and set the coil on the second notch of the blocks.

x. Tighten the four locking screws and check that the blocks are held firmly in place.

y. Center the coil around the klystron tube and check that the terminals are on the right side of the klystron carriage.

z. Repeat steps v through y for third body coil 3L3, setting the coil on the top notch of the supporting blocks.

aa. Repeat steps a, b, and f for the output cavity.

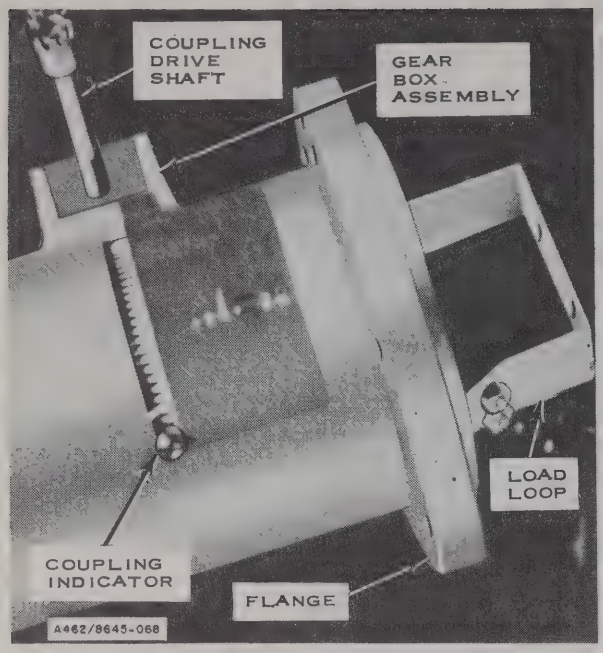

Figure 2-14. Output Load Coupler

ab. Set either half of the cavity onto the metal contact rings of the output cavity ceramic window (fig. 2-9) with the 3-1/8-inch flange opening facing the front of the klystron carriage.

ac. Hold the cavity half in place while the assistant installs the other cavity half, carefully aligning the contact fingers to prevent damage.

ad. Ensure that the coupling drive connecting shaft is meshed, then replace the four Allen-head screws using the T-wrench.

ae. Rotate the coupling drive shaft until the coupling indicator is set to the maximum coupling position as shown in figure 2-14.

af. Insert the load loop of the output load coupler into the opening on the front of the output cavity.

ag. Slip the flange of the output load coupler over the six bolts on the output cavity with the gear box assembly facing down.

ah. Secure the output load coupler with six 1/4-20 nuts, tightening them firmly and evenly to avoid rf arcing at the joint when the 10-kw power amplifier is operated.

CAUTION

Misalignment of the output load coupler bracket could result in damge to the output cavity caused by the weight of the output transmission line assembly.

ai. Attach the output load coupler support bracket to the bottom plate of the magnetic frame (fig. 2-15).

aj. Align the bracket to provide maximum support to the output load coupler, then secure firmly with the mounting screws.

ak. Connect the color-coded leads of the wiring harness on the magnetic frame (fig. 2-8) to the associated terminals of the body coils and the collector coil as follows:

Wire	To Terminal
white/red/gray	3L2 (-)
white/red/green	3L2 (+)
white/red/green	3L3 (-)
white/red/gray	3L3 (+)
white/red/green	3L4 (+)
white/violet/gray	3L5 (-)
white/red/green	3L5 (+)

2-42. INSTALLATION OF THE RF OUTPUT TRANSMISSION LINE ASSEMBLY. The rigid coaxial rf output transmission line assembly is comprised of rf line section 3W28, rf output directional coupler 3DC5, mode suppressor assembly 3W35, low pass filter 3FL1, rf line section 3W4, and rf elbow section 3W24, in that order. The installation will require the aid of an assistant.

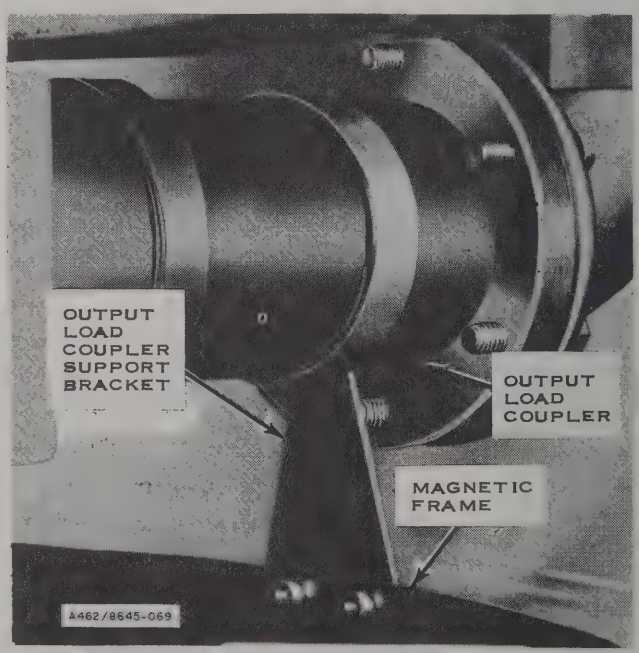

Figure 2-15. Output Load Coupler Support Bracket Installation

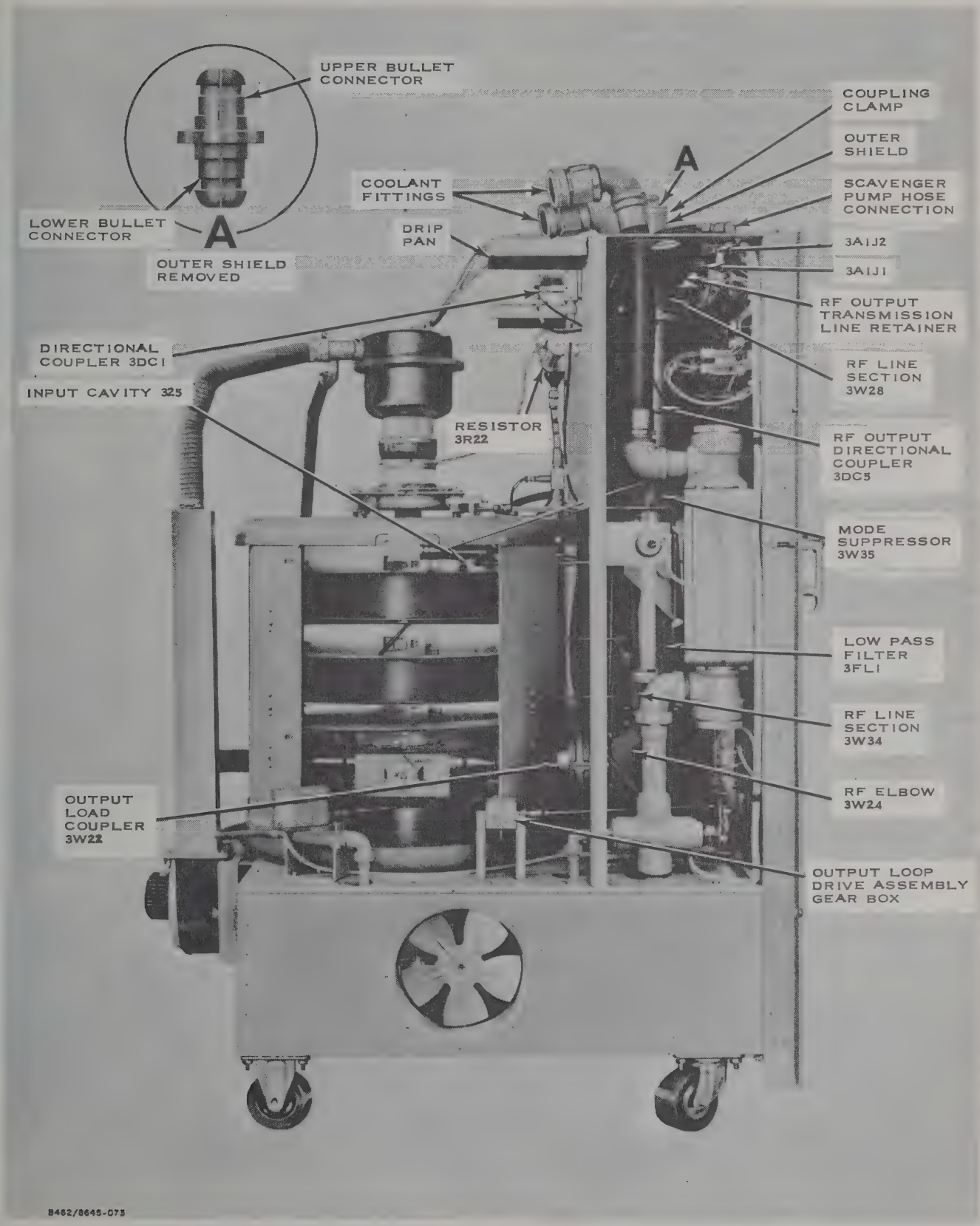

Figure 2-16. Klystron Carriage (Left Side)

NOTE

Before rf output directional coupler 3DC5 is connected to mode suppressor 3W35,. make sure that the side marked LOAD is at the top and the side with the two probe connectors is facing the left side of the klystron carriage.

a. Carefully assemble the rf output transmission line assembly in the following order (fig. 2-16), making sure that the flanges are evenly mated all around (secure firmly with 3/8-16 bolts):

(1) Sweep elbow section 3W24
(2) RF line section 3W34
(3) Low-pass filter 3FL1
(4) Mode suppressor assembly 3W35
(5) RF output directional coupler 3DC5
(6) RF transmission line section 3W28

b. Working from a raised platform, remove the rf output transmission on line retainer from the top of the klystron carriage.

c. Carefully lower the transmission line assembly, elbow end first, through the opening left by the removal of the rf output transmission line retainer.

d. While the assistant, working from the platform, steadies the top section, adjust the transmission line assembly until rf elbow section 3W24 (fig. 2-17) is level with the output load coupler.

e. Gradually insert the bullet section of the rf elbow section into the output load coupler until the flanges of the elbow section and the output load coupler mate evenly all around.

f. Secure the elbow section to the output load coupler with the 3/8-16 nuts and bolts provided.

g. While the assistant steadies the transmission line assembly, assemble the rf output transmission line retainer around rf line section 3W28.

h. Align the rf output transmission line retainer to the four holes on the top of the klystron carriage and secure firmly with four nuts and bolts.

2-43. INSTALLATION OF RF CABLES. Install the rf cables as follows:

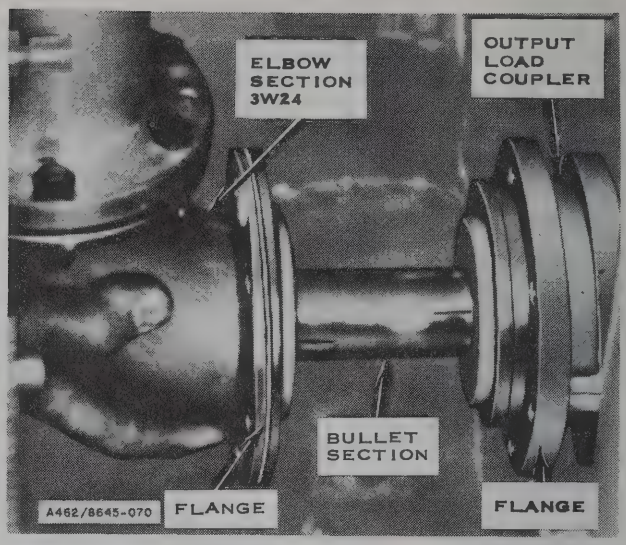

Figure 2-17. RF Output Transmission Line Installation

a. Connect rf cable 3W7 from directional coupler 3DC5, REFLECTED side, to coaxial connector 3CP11 (fig. 2-18).

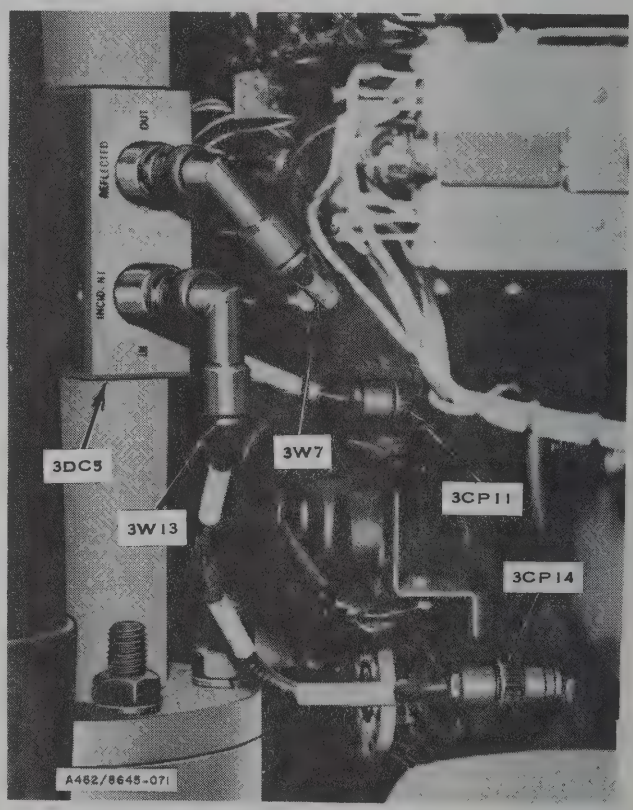

Figure 2-18. Output Directional Coupler RF Cable Connections

b. Connect rf cable 3W13 from directional coupler 3DC5, INCIDENT side, to coaxial connector 3CP14.

c. Connect rf cable 3W15 from directional coupler 3DC1, TRANSMITTER side (fig. 2-16), to jack 3J1 of input cavity 3Z5 (fig. 2-11).

d. Connect rf cable 3W16 from directional coupler 3DC2, TRANSMITTER side, to jack 3J3 of first cavity 3Z1 (see fig. 2-19).

e. Connect rf cable 3W18 from directional coupler 3DC3, TRANSMITTER side, to jack 3J4 of second cavity 3Z2 (see fig. 2-19).

f. Connect rf cable 3W20 from directional coupler 3DC4, TRANSMITTER side, to jack 3J5 of third cavity 3Z3 (see fig. 2-19).

2-44. INSTALLATION OF COUPLING ASSEMBLY DRIVE SHAFTS. Install the coupling assembly drive shafts as follows:

a. Insert the prefocus coil positioning coupling shafts for PREFOCUS COIL POSITIONING controls (fig. 2-7) through the front panel bearings (fig. 2-20). Secure each universal joint with two setscrews and install the retaining rings behind the panel bearings.

b. Install the spring-loaded drive shafts from the input, first, second, third, and output cavities to the corresponding front panel cavity tuning controls.

c. Rotate INPUT CAVITY TUNING, 1ST CAVITY TUNING, 2ND CAVITY TUNING, 3RD

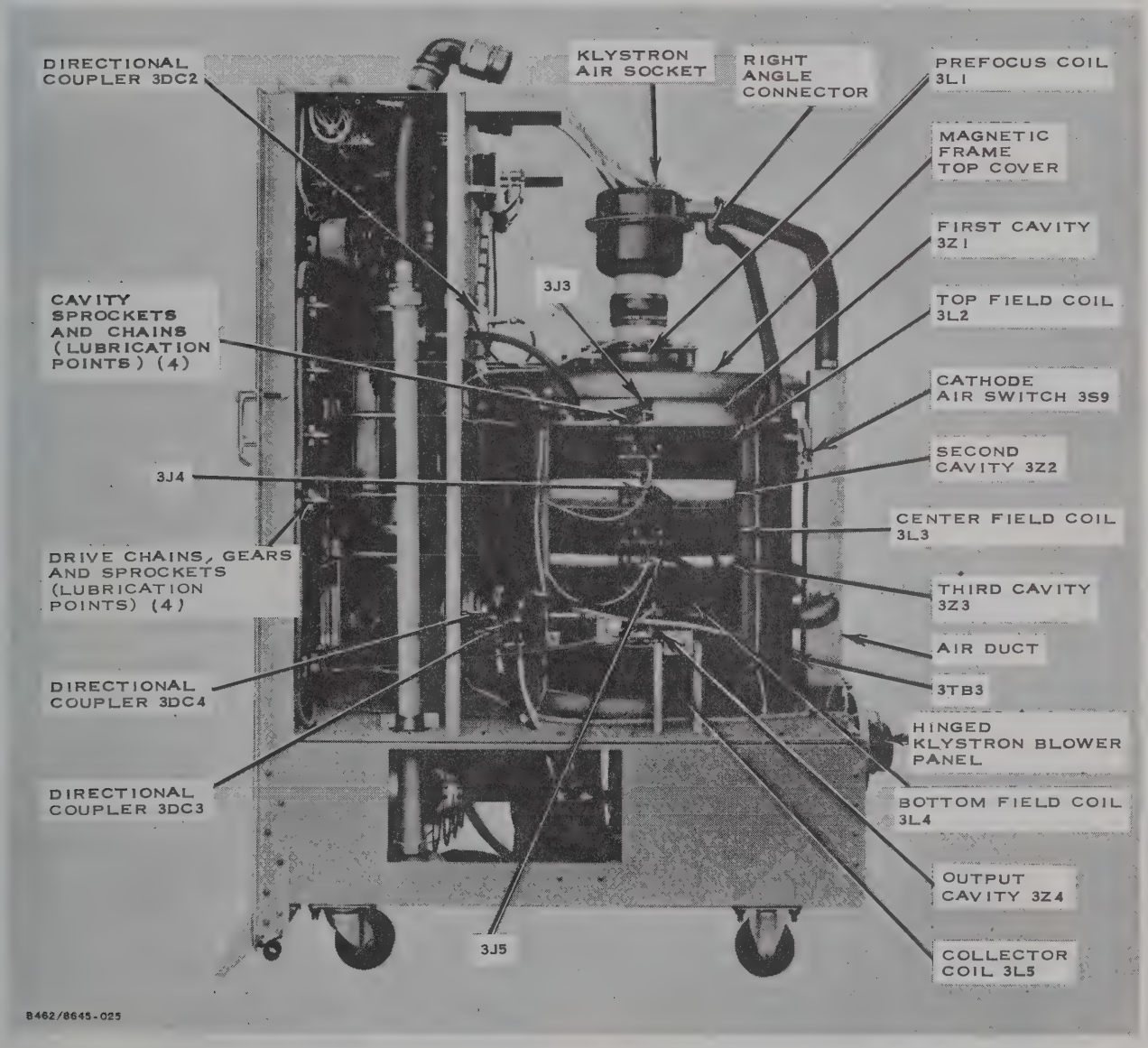

Figure 2-19. Klystron Carriage (Right Side)

CAVITY TUNING, and OUTPUT CAVITY TUNING controls (fig. 3-5) clockwise to the maximum positions.

d. Disconnect the spring-loaded drive shafts, set the cavity tuning controls until the counters read 9999, and reinstall the drive shafts.

e. Install a spring-loaded drive shaft from the gear box assembly coupling drive shaft on the output load coupler (fig. 2-14) to the output loop drive assembly gear box (fig. 2-16).

f. Install a spring-loaded drive shaft from the output loop drive assembly gear box to the front panel OUTPUT COUPLING ADJUST control.

g. Rotate OUTPUT COUPLING ADJUST control clockwise to the maximum position.

h. Disconnect the drive shaft from the front panel, set OUTPUT COUPLING ADJUST control until the counter reads 9999, and reinstall the drive shaft.

2-45. KLYSTRON AIR SOCKET ASSEMBLY AND AIR HOSE INSTALLATION. To install the klystron air socket assembly and air hose proceed as follows:

a. Close and secure the hinged klystron blower panel (fig. 2-19) at the rear of the klystron carriage.

b. Mount air hose adapter, with output cavity air switch 3S10 attached, over the opening in the rear of output cavity 3Z4 (fig. 2-21) and secure with four 1/4-20 nuts and washers.

c. Connect the white/gray/blue and white/gray/yellow leads from output cavity air switch 3S10 to terminals 1 and 2, respectively, of terminal board 3TB3.

d. Install air hose between air hose adapter and the fitting on the air duct and secure with clamps (figs. 2-19 and 2-21).

e. Check that the contact fingers of the klystron air socket (fig. 2-7) have not been damaged during shipment.

CAUTION

To prevent damage to the contact fingers, never rock or apply force other than a gradual downward pull with both hands to the air socket. Never lift or move the air socket by the air hose adapter.

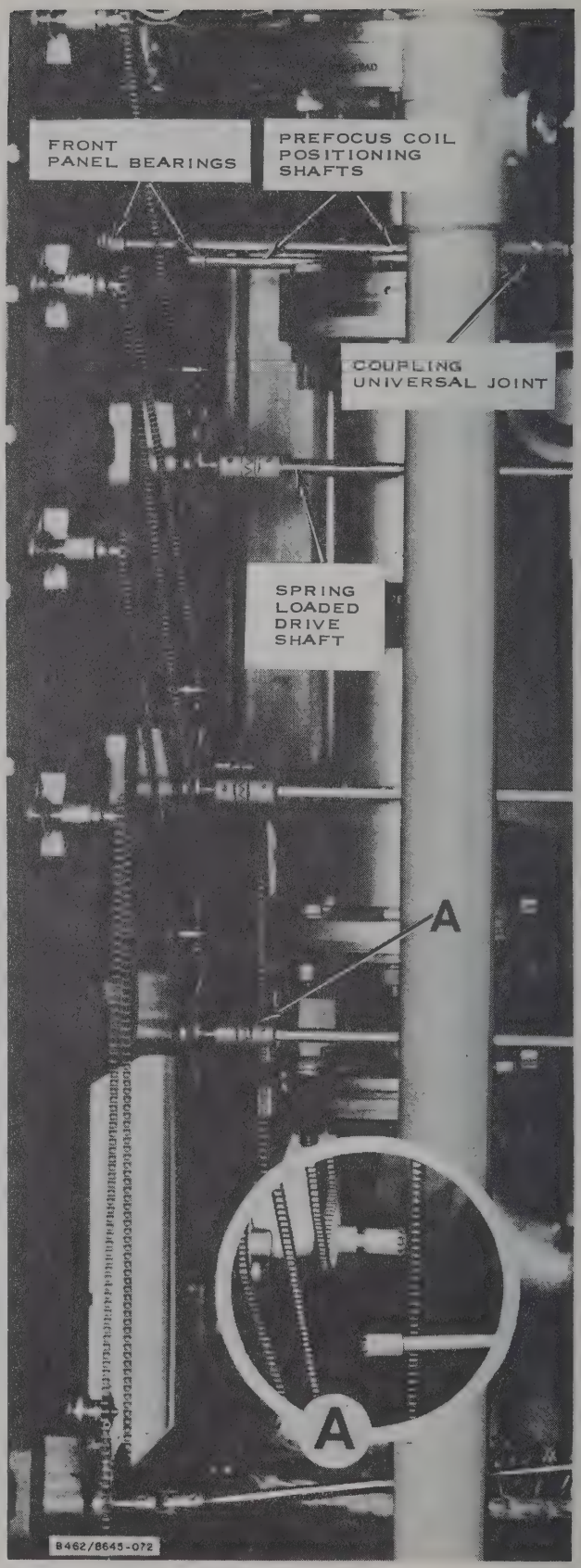

Figure 2-20. Cavity Drive Shaft Installation

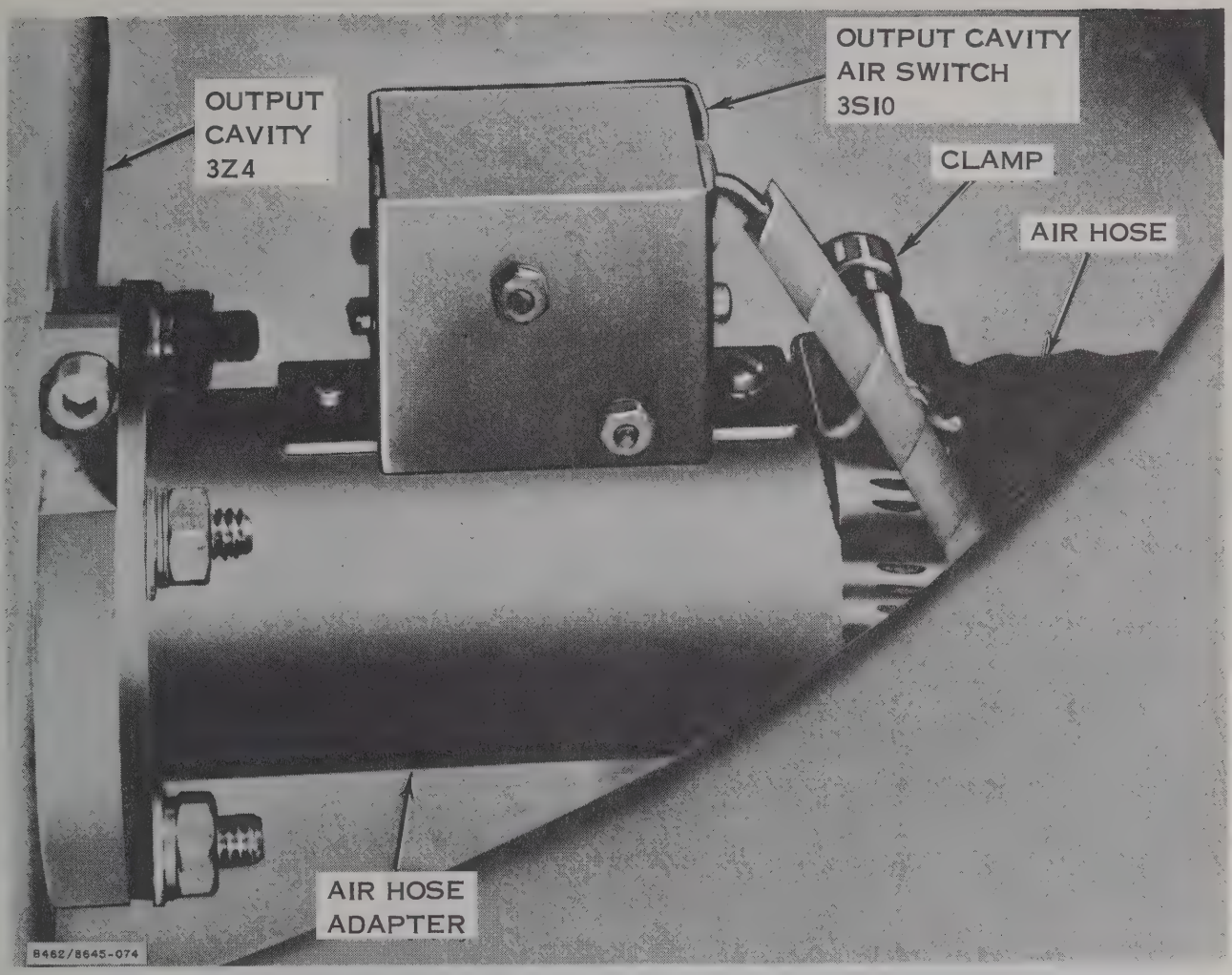

Figure 2-21. Air Hose Adapter Installation

f. Set the klystron air socket onto the tube, with the air hose connection to the rear, and check that the contact fingers are making even contact all around.

g. Applying even pressure with both hands, carefully move the klystron air socket down with a slight twisting motion until it is firmly seated on the klystron tube.

h. Install the air hose between the klystron air socket and the top of the air duct (fig. 2-19); secure with a clamp on each end.

i. Install the air hose between the right angle connector on the klystron air socket and cathode air switch 3S9; secure with a clamp on each end.

2-46. INSTALLATION OF THE KLYSTRON CARRIAGE. To install the klystron carriage refer to figures 2-16 and 2-22 and proceed as follows:

a. Install the two ramps in front of the amplifier section wheel guide channels, and clear away any obstruction between the klystron carriage and the amplifier section.

b. Release the two fasteners securing the meter panel and swing the meter panel fully open.

c. Align the klystron carriage to the ramps and check that the two handles on the front panel are in the horizontal position.

CAUTION

Roll the klystron carriage in a straight line. Position a man on each side to gauge the clearance and roll-in path. Do not allow the klystron carriage to bump against the amplifier cabinet.

d. Carefully roll the klystron carriage into the amplifier section of the amplifier cabinet and lock the klystron carriage in place by moving the handles down.

e. Remove the two ramps.

f. Connect plug 3P1 to jack 3A1J1 and plug 3P2 to jack 3A1J2.

g. Connect plug 3P9 to directional coupler 3DC1.

h. Connect the two quick-fit coolant fittings.

i. Connect the scavenger pump hose connection.

j. Line up the upper bullet connector of the rf transmission line section (at the top of the cabinet) with the lower bullet connector of the output transmission line section (in the klystron carriage).

k. Loosen the two coupling clamps on the output transmission line section and slide the outer shield up.

l. Using the two spanner wrenches provided on the top of the klystron carriage, connect the two bullet connectors together by holding the lower bullet connector stationary and rotating the upper bullet connector in the clockwise direction.

m. Slide the outer shield on the output transmission line section down and tighten the two coupling clamps.

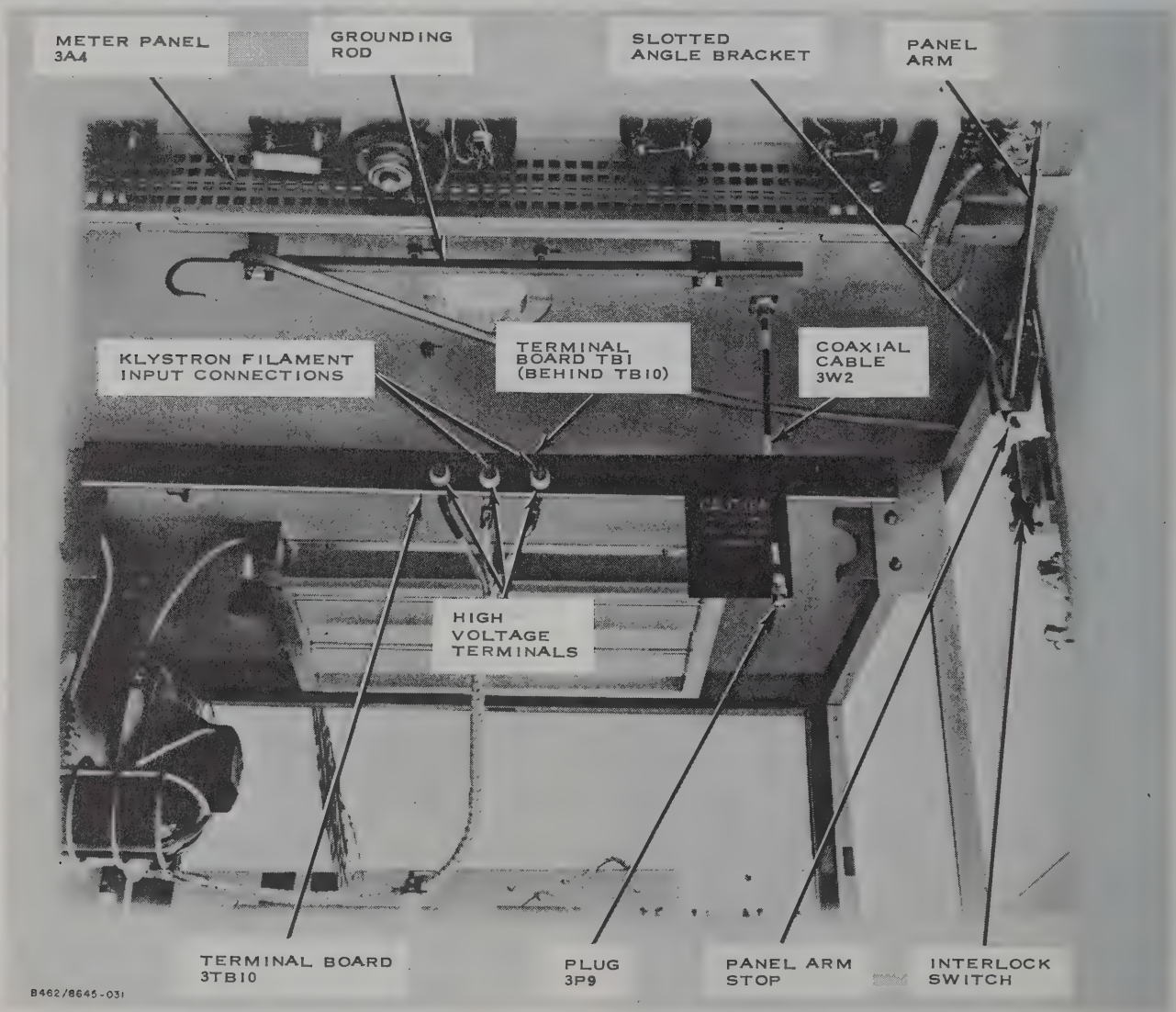

Figure 2-22. 10-KW Power Amplifier Cabinet with Meter Panel 3A4 Raised

n. Place terminal board 3TB1 (fig. 2-7) behind terminal board 3TB10 (fig. 2-22) and slide it to the right. Tighten the three wing nuts onto terminal board 3TB1.

o. Close the meter panel and tighten the two fasteners.

2-47. HEAT EXCHANGER PLUMBING CONNECTIONS.

2-48. Connect the required plumbing from the associated heat exchanger in accordance with the instructions given in the applicable technical manual and figure 2-1.

NOTE

The 10-kw power amplifier is normally used in conjunction with Cooler, Liquid, Electron Tube (heat exchanger) either HD-431/FRC-39A(V) or HD-661/FRC-39A(V)7 TM 11-5820-750-15.

2-49. POSTINSTALLATION TESTING, ALIGNMENT, AND ADJUSTMENT.

2-50. POSTINSTALLATION TESTING.

2-51. For the necessary postinstallation testing, a check of the following items must be made:

a. Ensure that the power connections to the 10-kw power amplifier are tight.

b. Ensure that the wiring and plumbing connections between the 10-kw power amplifier and associated heat exchanger are tight.

c. Ensure that all rf cable connections on the klystron carriage are tight.

d. Check that all cavity tuning controls on the klystron carriage are turned fully clockwise and that the counters read 9999.

e. Check the mechanical fit of the klystron carriage.

f. Check and ensure that all shorts are removed from rf meters on the klystron carriage. Also check and ensure that shorts are removed from capacitors 3C3 and 3C4.

2-52. POSTINSTALLATION ALIGNMENT AND ADJUSTMENT.

2-53. For postinstallation alignment and adjustment of the 10-kw power amplifier perform the alignment and adjustment procedures contained in Chapter 5.

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SECTION IV
PREPARATION FOR RESHIPMENT

2-54. INTRODUCTION. The instructions necessary to prepare the 10-kw power amplifier for reshipment are presented in this section. Before preparing the equipment for shipment, review the information provided in Section II.

2-55. SPECIAL INSTRUCTIONS.

2-56. When the equipment is prepared for shipment, all fasteners such as bolts, capscrews and machine screws should be attached to their associated components. If this is not possible, all small hardware used for a single assembly operation should be grouped together and packaged for shipment in cloth bags. All such packages of hardware and miscellaneous equipment should be labeled clearly, and every possible precaution taken against loss or misplacement during loading.

2-57. A desiccant dehydrator should be included in the equipment crates when the 10-kw power amplifier is prepared for shipment or storage. The dehydrating agent is available in small bags ranging in size from 1 ounce to 1 pound. Thus, the required amount can be distributed evenly throughout each crate.

2-58. DISASSEMBLY AND REMOVAL OF THE 10-KW POWER AMPLIFIER.

NOTE

Before starting the disassembly procedures, make certain that the main circuit breakers are positioned to OFF.

2-59. CABLING AND PLUMBING.

NOTE

Remove only those cables listed in table 2-2. Do not disturb any cables within the equipment.

2-60. Remove all interconnecting and power cabling listed in table 2-2 by removing all clamps, brackets, supports, etc., that are used to secure the various cables. Coil or bundle the cables for shipment.

2-61. Remove the heat exchanger plumbing in accordance with the instructions given in the applicable technical manual.

2-62. DISASSEMBLY AND REMOVAL OF THE AMPLIFIER SECTION.

2-63. REMOVAL OF THE KLYSTRON CARRIAGE. Remove the klystron carriage as follows:

a. Loosen the two knurled knobs on the meter panel. Swing the meter panel open, raising it until the locking-bar catches.

WARNING

Lethal voltages are present at the klystron carriage which could inflict serious injury or death. Exercise extreme care when grounding high voltage circuits.

b. Ground the terminals of 3TB10 (fig. 2-22) with the grounding rod.

c. Loosen the three wing nuts on high voltage terminal board 3TB1 (behind 3TB10). Remove terminal board 3TB1 from terminal board 3TB10 by sliding terminal board 3TB1 to the left.

d. Disconnect plug 3P9 from the input of directional coupler 3DC1 (fig. 2-16).

e. Disconnect the two quick-fit coolant fittings by pulling straight forward (towards the front of the klystron carriage) on the quick-fit coolant fittings.

f. Turn on the scavenger pump by operating the SCAVENGER PUMP switch (fig. 3-5) up-

ward; allow the scavenger pump to operate until water is drained from the klystron carriage.

g. Operate the SCAVENGER PUMP switch downward to shut off the scavenger pump.

h. Disconnect the scavenger pump hose connection (fig. 2-16).

i. Remove, drain, and replace the drip pan.

j. Disconnect plug 3P1 from jack 3A1J1 and plug 3P2 from jack 3A1J2.

k. Loosen the two coupling clamps on the transmission line and slide the outer shield up.

l. Using the two spanner wrenches provided on the top of the klystron carriage, loosen and separate the two bullet connectors by holding the lower bullet connector and rotating the upper bullet connector in the counterclockwise direction.

m. Raise the hinged wheel cover at the bottom of the klystron carriage and install the two ramp assemblies at the base of the amplifier cabinet.

CAUTION

Removal of the klystron carriage is always a two man operation. If the klystron carriage is to be removed within a mobile installation (such as Radio Set AN/MRC-85) it must be rolled onto a dolly. Use extreme care when rolling klystron carriage onto a dolly to avoid damage to the various fittings on the klystron carriage.

n. Loosen the two knurled knobs on the handles of the klystron carriage.

o. Carefully roll the klystron carriage out of the amplifier cabinet.

2-64. DISASSEMBLY OF THE KLYSTRON CARRIAGE. Remove the klystron air socket assembly and air hose by performing the reverse of the installation procedure contained in paragraph 2-45.

2-65. Remove the coupling assembly drive shafts by performing the reverse of the procedure contained in paragraph 2-44.

2-66. Remove rf cables by performing the reverse of the installation procedure contained in paragraph 2-43.

2-67. Remove the rf output transmission line assembly by performing the reverse of the installation procedure contained in paragraph 2-42.

2-68. Remove the klystron cavities by performing the reverse of the installation procedure contained in paragraph 2-41 (with the exception of steps ae, f, d, c, and b).

2-69. Remove the prefocus coil assembly by performing the reverse of the installation procedure contained in paragraph 2-40.

2-70. Remove the coolant lines by performing the reverse of the installation procedure contained in paragraph 2-39.

2-71. Removal of Klystron Tube. Remove the klystron tube as follows:

a. Prepare a raised platform on the left side of the klystron carriage.

b. Remove the two halves of the neck supporting plates (fig. 2-7) from the top opening of the magnetic frame.

c. Working from the platform, grasp the klystron tube by the neck (fig. 2-9) with both hands and, while an assistant guides the tube, carefully raise the tube until the collector end clears the top of the magnetic frame.

d. Carefully rest the collector end of the tube on top of the magnetic frame (fig. 2-7).

e. Keep one hand around the neck of the tube and shift the other hand to the collector just below the mounting flange (fig. 2-9).

f. Carefully rotate the tube to the horizontal position and transfer it to the assistant by the neck and below the mounting flange.

g. The assistant must carry the tube to the klystron tube shipping crate and carefully place the tube inside the padded crate.

h. Close and seal the plastic wrapper around the tube, replace the top padding over the tube, and replace the cover of the crate.

2-72. Removal of the Collector Coil and Body Coils. Remove the collector coil and the body coils by performing the reverse of the installation procedure contained in paragraph 2-37.

2-73. REMOVAL OF FIELD COILS VARIABLE AUTOTRANSFORMER 3A6. Remove field coils variable autotransformer by performing the reverse of the installation procedure contained in paragraph 2-34.

2-74. Remove the amplifier section of the 10-kw power amplifier by performing the reverse of the installation procedure contained in paragraph 2-33.

2-75. DISASSEMBLY AND REMOVAL OF POWER SECTION.

2-76. Remove the beam power supply transformer 3T4, bias control assembly, capacitors 3C3 and 3C4, autotransformers 3T2 and 3T3, and rectifiers 3CR1 through 3CR6 by performing the reverse of the procedures contained in paragraphs 2-31, 2-30, 2-29, 2-28, and 2-27, respectively.

WARNING

When removing the beam power components, ensure that all high-voltage terminals are shorted with the grounding rod provided on the rear of meter panel 3A4 (fig. 2-22). Capacitors 3C3 and 3C4 must be shorted before shipment to avoid buildup of static charges.

2-77. Connect a length of No. 12 AWG wire between the terminals of capacitor 3C3 (fig. 2-3); and a similar wire between the terminals of capacitor 3C4.

2-78. Remove the floor bolts from the power section and remove the power section.

2-79. SPECIAL CRADLES OR MOUNTING NECESSARY FOR RESHIPMENT.

2-80. With the exception of the klystron tube (para. 2-71), no special cradles or mountings are necessary for reshipment.

2-81. PREPARATION FOR PACKING.

2-82. The components of the 10-kw power amplifier are shipped in crates that are not reusable, with the exception of the klystron tube crate. Therefore, when preparing the equipment for reshipment, build the required number of crates in accordance with MIL-P-7936. Refer to table 2-1 for crating data.

2-83. REPACKING IN CRATES.

2-84. Place components of the 10-kw power amplifier into the appropriate crates and bolt the equipment to floor of the crates. Refer to MIL-P-7936 for more detailed information.

CHAPTER 3
OPERATION

3-1. INTRODUCTION. This chapter furnishes complete instructions for operating the 10-kw power amplifier. It is assumed that all of the postinstallation tune-up procedures in Chapter 5 have been performed and that the system is operative. Section I lists and illustrates the controls and indicators necessary for proper operation. Section II describes the correct method of applying power and turning off power under normal and emergency conditions. Section III, Emergency Operation, is not applicable.

SECTION I
CONTROLS AND INDICATORS

3-2. IDENTIFICATION OF CONTROLS AND INDICATORS.

3-3. Tables 3-1 through 3-7 list and describe all of the controls and indicators used to operate and maintain the 10-kw power amplifier. The test jacks are listed in Chapter 5.

3-4. Figures 3-1 through 3-7 illustrate the controls and indicators used to operate the 10-kw power amplifier. The controls and indicators, listed in tables 3-1 through 3-6, used to maintain and align the 10-kw power amplifier, are illustrated in Chapter 5.

3-5. POWER INTERLOCKS.

3-6. Table 3-8 lists and describes the function of each interlock used in the 10-kw power amplifier.

Table 3-1. 10-kw Power Amplifier Cabinet Controls and Indicators (see fig. 3-1)

Name	Reference Designation	Function
THREE PHASE PWR ON indicator lamp	3DS1	Comes on when 208 V, 60 cps, three-phase power is applied to the 10-kw power amplifier
SINGLE PHASE PWR ON indicator lamp	3DS2	Comes on when 120 V, 60 cps, single-phase power is applied to the 10-kw power amplifier
MAIN PWR ON indicator lamp	3DS3	Comes on when MAIN POWER circuit breaker on the distribution panel is set to ON
HEAT EXCH ON indicator lamp	3DS4	Comes on when HEAT EXCHANGER switch on the ac control panel is set to ON
CIRCULATION FAN ON indicator lamp	3DS5	Comes on when CABINET AIR COOLING PWR circuit breaker on the control panel is set to ON

Table 3-1. 10-kw Power Amplifier Cabinet Controls and Indicators (see fig. 3-1) (cont)

Name	Reference Designation	Function
CARRIAGE AIR COOLING ON indicator lamp	3DS6	Comes on when KLYSTRON AIR COOLING PWR circuit breaker on the ac control panel is set to ON
SINGLE PHASE REG ON indicator lamp	3DS7	Comes on when REGULATED POWER circuit breaker on the ac control panel is set to ON
FILAMENT CKT ON indicator lamp	3DS8	Comes on when all filament circuit breakers are on and the KLYSTRON FIL VOLT ADJUST control on the ac control panel is operated past 3.5
INTERLOCKS CLOSED indicator lamp	3DS9	Comes on when all interlocks are closed
BEAM T.D. OVER indicator lamp	3DS10	Comes on 5 minutes after the application of filament power to klystron tube to indicate that beam voltage can be applied
BEAM ON indicator lamp	3DS11	Comes on to indicate application of beam power
Outlet valve	--------	Controls coolant flow out of klystron carriage
LINE STRETCHER ADJUST control	--------	Lengthens or shortens the coaxial input matching section
LOCK-UNLOCK lever	--------	Clamps or loosens the line stretcher to allow adjusting
RF OUTPUT SAMPLE ADJ control	--------	Adjusts rf output level at RF OUTPUT SAMPLE jack J4
Inlet valve	--------	Controls coolant flow into klystron carriage

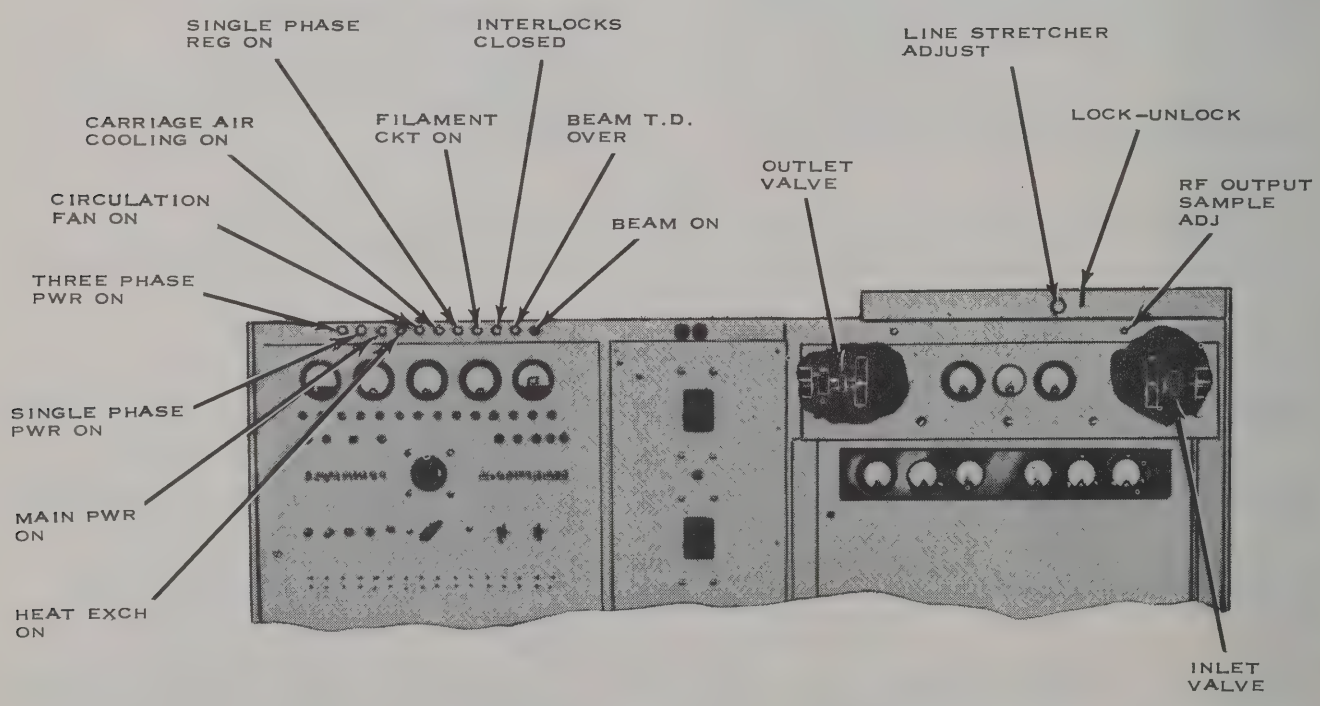

Figure 3-1. 10-kw Power Amplifier Cabinet, Controls and Indicators

Table 3-2. AC Control Panel, Upper Half Controls and Indicators (see fig. 3-2)

Name	Reference Designation	Function
FILAMENT HOURS meter	3A3M1	Indicates total klystron filament operating time
PANEL OUT indicator lamp	3A3DS3	Comes on when the connector is removed from either the power supply or one of the regulator control panels
ALARM PS FAILURE indicator lamp	3A3DS4	Comes on when the alarm power supply is inoperative
GETTER POWER indicator lamp	3A3DS18	Comes on when the GETTER POWER circuit breaker opens
KLYSTRON FIL VOLTS meter	3A3M2	Monitors the klystron filament voltage
FIL UNREG indicator lamp	3A3DS5	Comes on when interruption occurs in 120 vac regulation circuit
FIL REG LIMIT indicator lamp	3A3DS6	Comes on when the upper or lower regulated filament voltage limit is reached
BEAM REG PRI OL indicator lamp	3A3DS7	Comes on when the BEAM CONTROL VOLTAGE circuit breaker opens
LINE VOLTS meter	3A3M3	Monitors line voltage selected by the LINE VOLTS switch
BEAM PRI OVERLOAD indicator lamp	3A3DS8	Comes on when the BEAM AC OVERLOAD circuit breaker opens
BEAM OVERLOAD indicator lamp	3A3DS9	Comes on when beam voltage overload occurs
KLYSTRON FIL CURRENT meter	3A3M4	Monitors klystron filament current
BEAM VOLTS LIMIT LOW indicator lamp	3A3DS1	Comes on when the beam voltage lower limit is reached
BEAM VOLTS LIMIT HIGH indicator lamp	3A3DS11	Comes on when the beam voltage upper limit is reached
BEAM HOURS meter	3A3M5	Indicates total beam power supply operating time
RECYCLE indicator lamp	3A3DS12	Comes on for one second to indicate that a dc overload has occurred and that the recycle circuit has been activated
BODY OVERLOAD indicator lamp	3A3DS13	Comes on when excessive klystron body current is present
AUTOMATIC indicator lamp	3A3DS14	Goes on when the AUTOMATIC-NORMAL-RESET switch is turned to AUTOMATIC, denoting automatic operation of recycle circuit
FIL POWER indicator lamp	3A3DS21	Comes on when the FIL POWER circuit breaker opens
PREFOCUS COIL PWR indicator lamp	3A3DS22	Comes on when the PREFOCUS COIL PWR circuit breaker opens
ALARM POWER indicator lamp	3A3DS23	Comes on when the ALARM POWER circuit breaker opens
FIELD COILS POWER indicator lamp	3A3DS20	Comes on when the FIELD COILS POWER circuit breaker opens
PUMP POWER indicator lamp	3A3DS19	Comes on when the PUMP POWER circuit breaker opens
ALARM POWER circuit breaker	3A3CB11	Protects from damage due to overloads and controls ac input to alarm power supply
PREFOCUS COIL PWR circuit breaker	3A3CB10	Protects from damage due to overloads and controls ac input to prefocus coil power supply
FIL POWER circuit breaker	3A3CB9	Protects from damage due to overloads and controls the input to the filament power supply

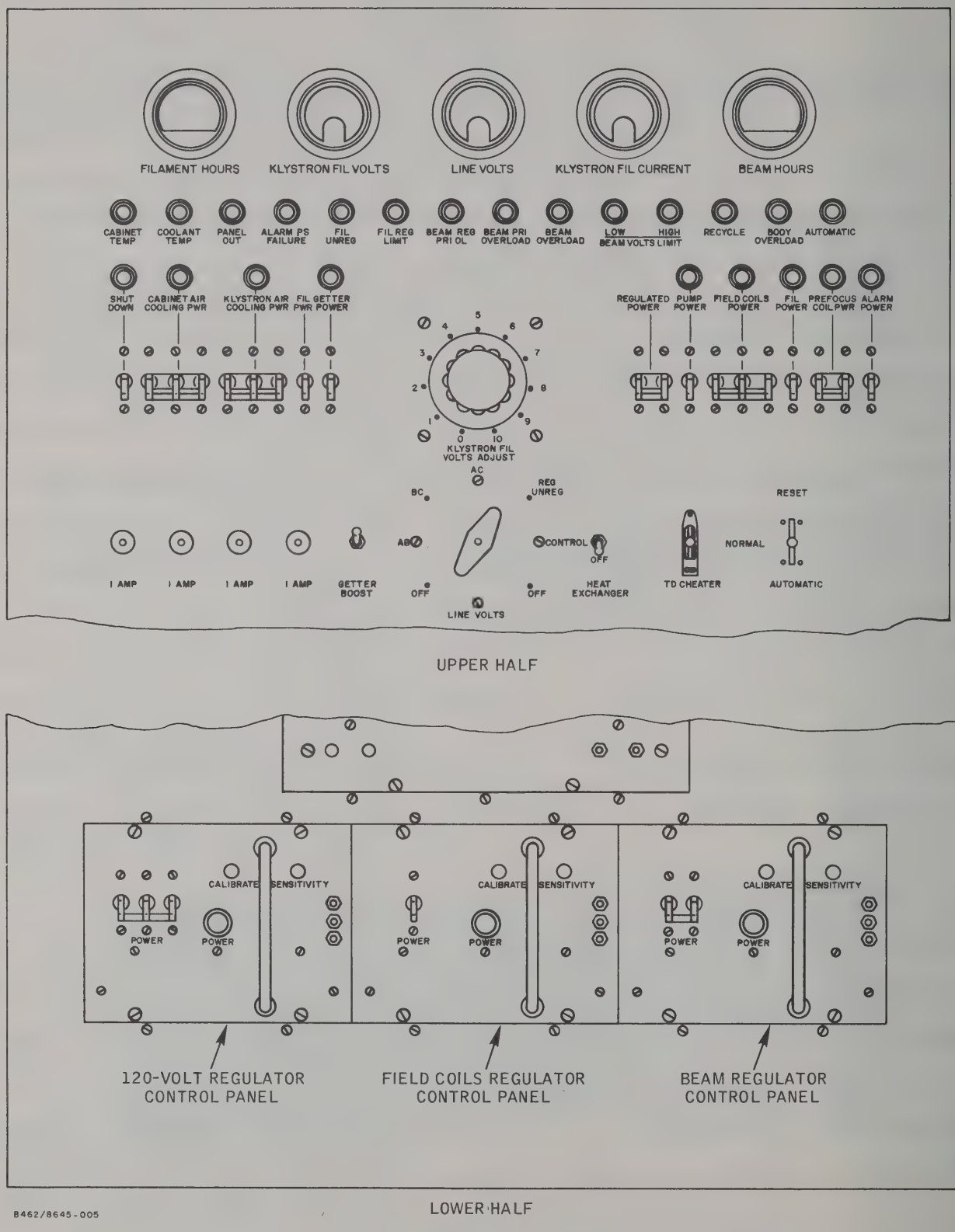

Figure 3-2. AC Control Panel, Controls and Indicators

Table 3-2. AC Control Panel, Upper Half Controls and Indicators (see fig. 3-2) (cont)

Name	Reference Desig-nation	Function
FIELD COILS POWER circuit breaker	3A3CB8	Protects from damage due to overloads and controls ac input to field coils power supply
PUMP POWER circuit breaker	3A3CB7	Protects from damage due to overloads and controls power to the scavenger pump motor switch, SCAVENGER PUMP 3A1S11
RESET-NORMAL-AUTOMATIC switch	3A3S6	In RESET, resets the ac power distribution control circuit, after the fault condition has been corrected. Permits automatic operation (recycling) in AUTOMATIC
REGULATED POWER circuit breaker	3A3CB6	Protects from damage due to overloads and controls primary voltage to the 120-volt regulator
TD CHEATER switch	3A3S5	Allows emergency turn on of 10-kw power amplifier without waiting for 5-minute delay between filament and beam voltage turn on
HEAT EXCHANGER switch	3A3S4	Remotely turns on heat exchanger
KLYSTRON FIL VOLTS ADJUST control	3A3T1	Adjusts the klystron filament voltage
LINE VOLTS switch	3A3S3	Selects the voltage to be monitored by the LINE VOLTS meter
GETTER BOOST switch	3A3S2	Momentarily doubles getter voltage when increased klystron gas absorption is required
GETTER POWER circuit breaker	3A3CB5	Protects from damage due to overload and controls primary power to the klystron getter transformer
FIL PWR circuit breaker	3A3CB4	Controls power applied to FIL POWER, GETTER POWER, and PREFOCUS COIL PWR circuit breakers. Opens the circuit if the total current through these circuit breakers is excessive, although no individual circuit breaker overload exists
KLYSTRON AIR COOLING PWR circuit breaker	3A3CB3	Protects from damage due to overload and controls power to the klystron blower and circulating fans
CABINET AIR COOLING PWR circuit breaker	3A3CB2	Protects from damage due to overload and controls power to one cabinet circulating fan and two thermostatically controlled intake fans
SHUT DOWN circuit breaker	3A3CB1	Protects from damage due to overload and controls power to the ac distribution system control circuitry; can be used as master shutoff switch
CABINET AIR COOLING PWR indicator lamp	3A3DS16	Comes on when the CABINET AIR COOLING PWR circuit breaker opens
SHUT DOWN indicator lamp	3A3DS15	Comes on when SHUT DOWN circuit breaker opens
KLYSTRON AIR COOLING PWR indicator lamp	3A3DS17	Comes on when the KLYSTRON AIR COOLING PWR circuit breaker opens
CABINET TEMP indicator lamp	3A3DS1	Comes on when cabinet temperature exceeds the proper limit
COOLANT TEMP indicator lamp	3A3DS2	Comes on when the coolant thermal overload switch opens the beam power supply control circuit

Table 3-3. AC Control Panel, Lower Half Controls and Indicators (see fig. 3-2)

Name	Reference Designation	Function
Beam Regulator Control Panel:		
SENSITIVITY control	3A3A4R5	Adjusts rate of change (sensitivity) of regulation circuit
CALIBRATE control	3A3A4R4	Adjusts the balance point of the voltage-sensitive bridge
POWER indicator lamp (amber)	3A3A4DS1	Comes on when the POWER circuit breaker opens
POWER circuit breaker	3A3A4CB1	Protects from damage due to overload and controls the power to the beam regulator control panel
Field Coils Regulator Control Panel:		
SENSITIVITY control	3A3A2R11	Adjusts rate of change (sensitivity) of regulation circuit
CALIBRATE control	3A3A2R3	Adjusts the balance point of the voltage-sensitive bridge
POWER indicator lamp (amber)	3A3A2DS1	Comes on when the POWER circuit breaker opens
POWER circuit breaker	3A3A2CB1	Protects from damage due to overload and controls power to the field coils regulator control panel
120-volt Regulator Control Panel:		
SENSITIVITY control	3A3A1R5	Adjusts rate of change (sensitivity) of regulation circuit
POWER indicator lamp (amber)	3A3A1DS1	Comes on when the POWER circuit breaker opens
POWER circuit breaker	3A3A1CB1	Protects from damage due to overload and controls power to the 120-volt regulator control panel
CALIBRATE control	3A3A1R4	Adjusts the balance point of the voltage-sensitive bridge

Table 3-4. Distribution Panel, Controls and Indicators (see fig. 3-3)

Name	Reference Designation	Function
MAIN POWER circuit breaker	3A2CB1	Protects the 10-kw power amplifier from damage due to overload. Controls 208 vac, 3-phase input to 10-kw power amplifier
BEAM POWER circuit breaker	3A2CB2	Protects from damage due to overload and controls ac power input to beam power supply
BIAS VOLTAGE ADJUST control	3A2R6	Adjusts the klystron cathode bias voltage
BEAM CONTROL VOLTAGE circuit breaker	3A2CB3	Protects from damage due to overload and controls variable ac input voltage to the beam power supply
BEAM AC OVERLOAD circuit breaker	3A2CB4	Protects from damage due to overload and controls the ac applied to the primary of the beam power transformer
BEAM REGULATOR POSITION indicator	---------	Indicates the relative position of the beam power primary control rotor
BIAS VOLTAGE meter	3A2M1	Monitors klystron cathode bias voltage
BEAM POWER FAILURE indicator lamp (amber)	3A2DS1	Comes on to indicate that the BEAM POWER circuit breaker is open

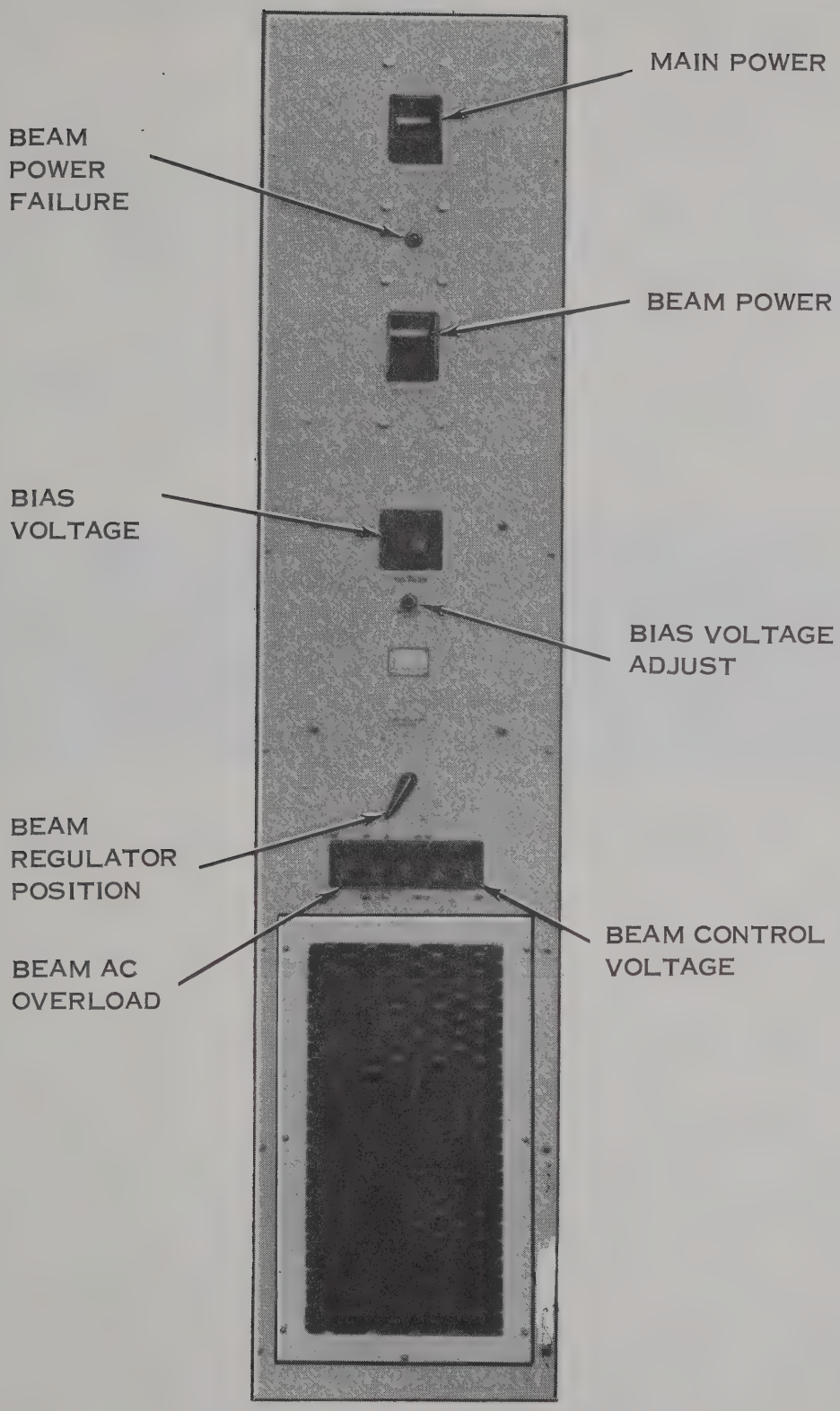

Figure 3-3. Distribution Panel, Controls and Indicators

Table 3-5. Meter Panel Indicators (see fig. 3-4)

Name	Reference Designation	Function
BEAM VOLTS meter	3A4M1	Monitors beam voltage applied to klystron
BEAM CURRENT meter	3A4M2	Monitors beam current drawn by klystron
BODY CURRENT meter-relay	3A4M3	Monitors klystron body current and removes beam voltage if an overload occurs
PREFOCUS COIL CURRENT meter	3A4M4	Monitors klystron prefocus coil current
FIELD COILS CURRENT meter	3A4M5	Monitors klystron field coils current
VERY HIGH VSWR indicator lamp	3A4DS3	Comes on when back power output exceeds the preset very high vswr value
HIGH VSWR indicator lamp	3A4DS2	Comes on when back power output exceeds the preset high vswr value, or when output cavity is arcing
LOW FWD POWER indicator lamp	3A4DS1	Comes on when forward rf output falls below the preset limit

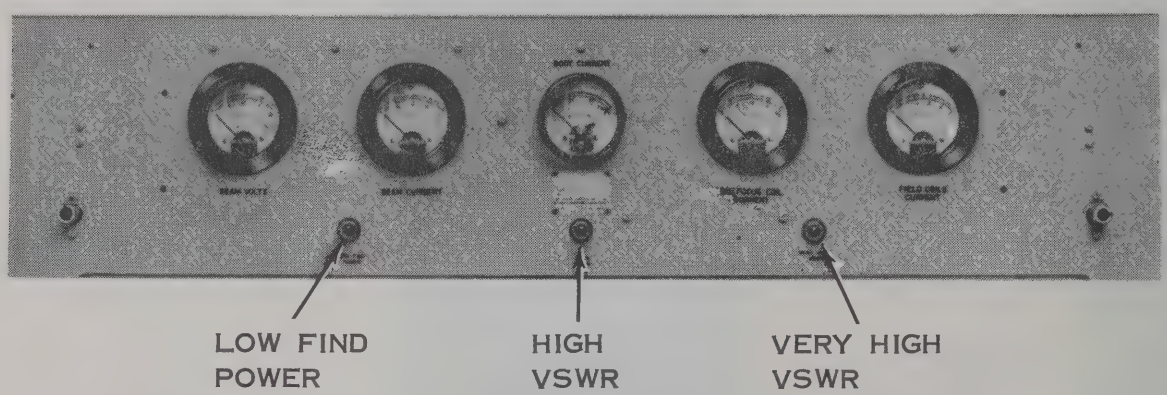

Figure 3-4. Meter Panel, Controls and Indicators

Table 3-6. Klystron Carriage, Controls and Indicators (see fig. 3-5)

Name	Reference Designation	Function
INPUT FORWARD-1ST CAVITY LOAD switch	3A1S1	Selects power to be measured by INPUT FORWARD-1ST CAVITY LOAD meter
INPUT FORWARD-1ST CAVITY LOAD meter	3A1M1	Monitors forward rf input power or rf power in the first cavity load as selected by the INPUT FORWARD-1ST CAVITY LOAD switch
INPUT BACK CAL control	3A1R3	Adjustable series calibration resistor for INPUT BACK meter
INPUT BACK meter	3A1M2	Monitors reflected rf input power
TUNE-FS 2 WATTS switch	3A1S12	Provides series resistance protection for the INPUT FORWARD-1ST CAVITY LOAD meter during initial rough tuning, in TUNE position; connects CAL control in series with meter for normal calibration in FS 2 WATTS position
OUTPUT FORWARD CAL control	3A1R4	Adjustable series calibration resistor for OUTPUT FORWARD meter

Table 3-6. Klystron Carriage, Controls and Indicators (see fig. 3-5) (cont)

Name	Reference Designation	Function
SCAVENGER PUMP switch	3A1S11	Turns on the scavenger pump
SCAVENGER PUMP ON indicator lamp (white)	3A1DS2	Goes on when the scavenger pump is operating
OUTPUT COUPLING ADJUST control	----------	Adjusts the rf output coupling
INPUT CAVITY TUNING control	----------	Tunes input cavity Z5
KLYSTRON COOLANT FLOW gauge	----------	Indicates the flow rate of coolant
INPUT COUPLING ADJUST control	----------	Adjusts the rf coupling to the first cavity of the klystron
BEAM VOLTAGE ADJUST control	3A1R13A,B	Selects the beam voltage at which the beam regulator control operates
BEAM VOLTAGE OFF pushbutton	3A1S3	Turns off beam voltage
BEAM VOLTAGE RAISE-LOWER switch	3A1S4	Manually sets the level of beam voltage, with the regulator turned off
BEAM VOLTAGE ON pushbutton	3A1S2	Turns on beam voltage
INPUT FORWARD CAL control	3A1R1	Adjustable series calibration resistor for INPUT FORWARD-1ST CAVITY LOAD meter when the meter is measuring rf input power
1ST CAVITY LOAD CAL control	3A1R2	Adjustable series calibration resistor for INPUT FORWARD-1ST CAVITY LOAD meter when the meter is measuring rf power in the first cavity load
OUTPUT FORWARD meter-relay	3A1M3	Monitors forward rf output power
SCOPE LEVEL ADJUST control (1st cavity)	3A1R9	Adjusts level of sampled 1st cavity rf voltage from DC2 through CAVITY SELECTOR switch tc SCOPE JACK 3A1J6
CAL HIGH VSWR control	3A1R5	Adjustable series calibration for resistor low range of OUTPUT BACK meter-relay
OUTPUT BACK meter-relay	3A1M4	Monitors reflected rf output power. Also turns off beam voltage if rf output back power rises past preset values
CAL VERY HIGH VSWR control	3A1R6	Adjustable series calibration resistor for high range of OUTPUT BACK meter-relay
SCOPE LEVEL ADJUST control (2nd cavity)	3A1R10	Adjusts level of sampled 2nd cavity rf voltage from DC3 through CAVITY SELECTOR switch tc SCOPE JACK 3A1J6
2ND CAVITY LOAD meter	3A1M5	Monitors rf power in second cavity load
2ND CAVITY LOAD CAL control	3A1R7	Adjustable series calibration resistor for 2ND CAVITY LOAD meter
3RD CAVITY LOAD meter	3A1M6	Monitors rf power in third cavity load
3RD CAVITY LOAD CAL control	3A1R8	Adjustable series calibration resistor for 3RD CAVITY LOAD meter
SCOPE LEVEL ADJUST control (3rd cavity)	3A1R11	Adjusts level of sampled 3rd cavity rf voltage from DC4 through CAVITY SELECTOR switch to SCOPE JACK 3A1J6
PREFOCUS COIL CURRENT ADJUST control	3A1T1	Controls klystron prefocus coil current
SCOPE LEVEL ADJUST OUTPUT control	3A1R12	Adjusts level of sampled output cavity rf voltage from DC5 through CAVITY SELECTOR switch to SCOPE JACK 3A1J6
CAVITY SELECTOR switch	3A1S5	Couples the output of the selected cavity to SCOPE JACK J6
1ST CAVITY TUNING control	----------	Tunes the first cavity of the klystron
2ND CAVITY TUNING control	----------	Tunes the second cavity of the klystron

Table 3-6. Klystron Carriage, Controls and Indicators (see fig. 3-5) (cont)

Name	Reference Designation	Function
PREFOCUS COIL POSITIONING controls	----------	Adjusts the position of the prefocus coil
3RD CAVITY TUNING control	----------	Tunes the third cavity of the klystron
OUTPUT CAVITY TUNING control	----------	Tunes the output cavity of the klystron
COOLANT TEMP OVERLOAD RESET pushbutton	3A1S8	Resets the coolant temperature overload circuit

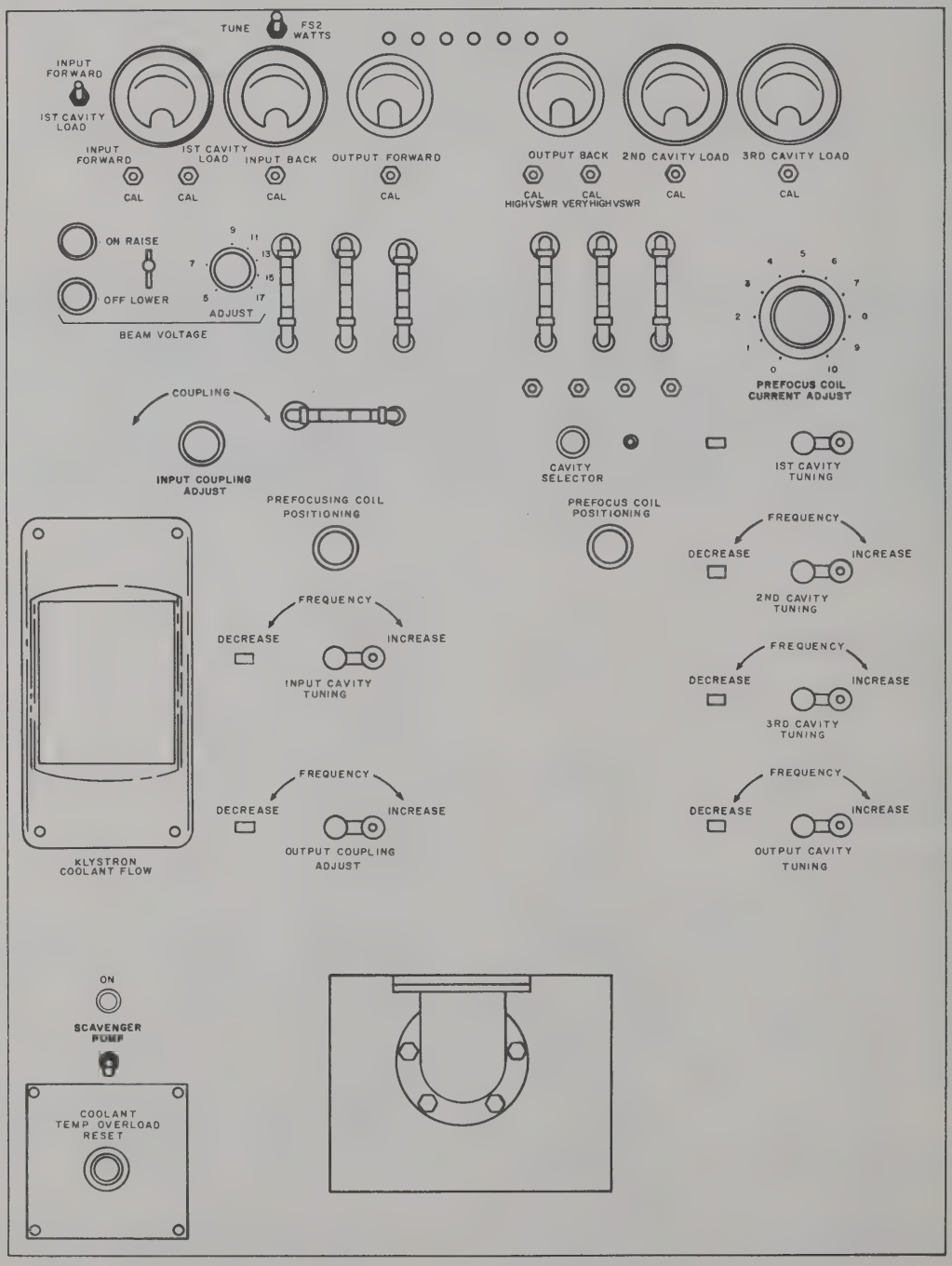

Figure 3-5. Klystron Carriage, Controls and Indicators

Table 3-7. Beam Power Supply Transformer, Controls and Indicators (see fig. 3-6)

Name	Function
Inspection window	Allows examination of beam power transformer desiccant
1/4 inch cutoff valve	Opens or closes line to breather tank
Oil level meter	Indicates level of oil in beam power transformer
Upper filter press valve	Used in conjunction with oil drainage valve during reconditioning of insulating oil
Oil drainage valve	Provides for drainage of the beam power transformer

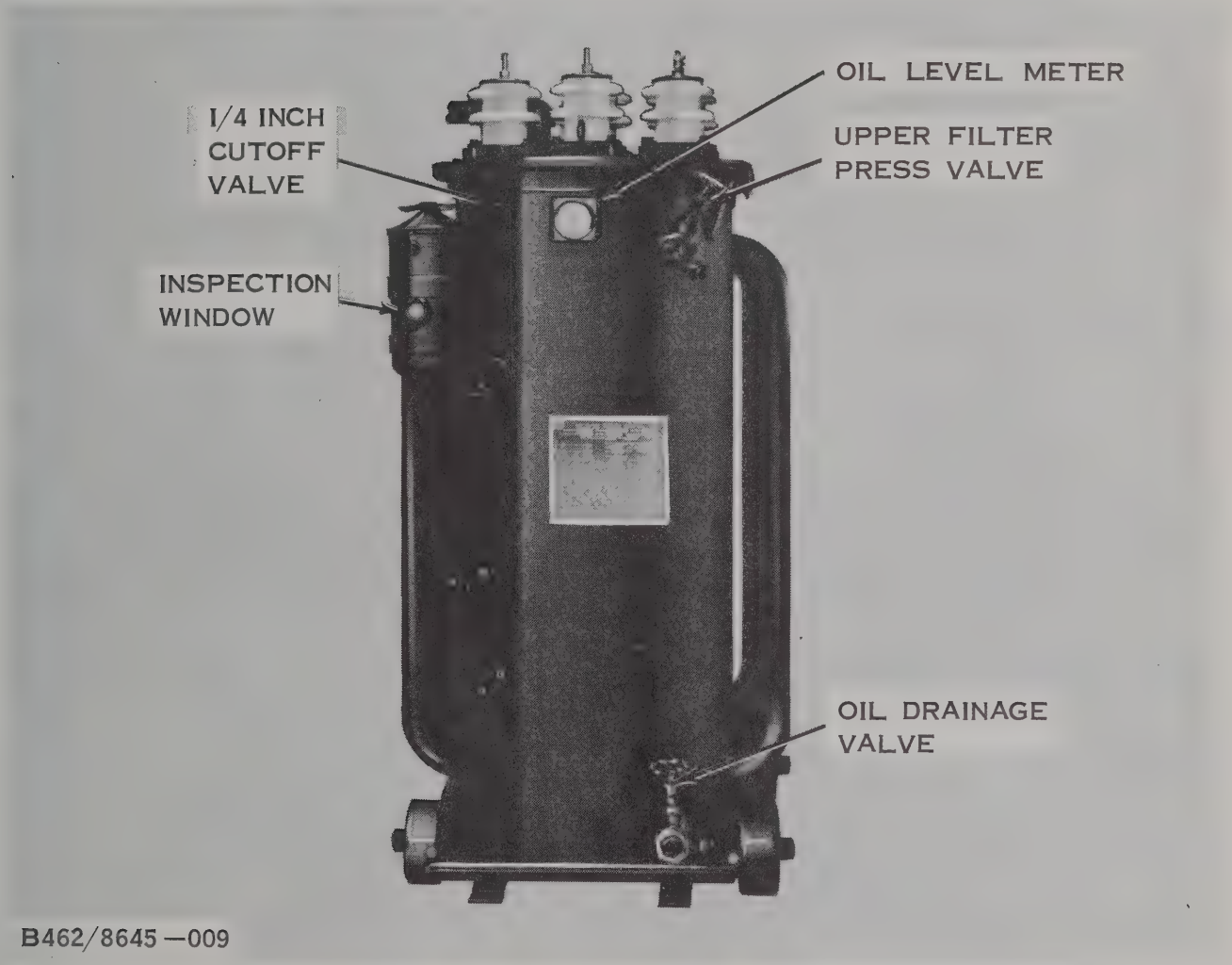

Figure 3-6. Beam Power Supply Transformer, Controls and Indicators

Table 3-8. Interlocks

Reference Designation	Location	Disables
3S3	Interior, upper front, right edge of amplifier cabinet	Beam power supply on pullout of meter panel
3S4	Interior, upper front, left edge of amplifier cabinet	Beam power supply on pullout of ac control panel
3S6	Interior, upper middle, rear edge of amplifier cabinet	Beam power supply on removal of left rear cover
3S7	Interior, upper front, right edge of amplifier cabinet	Beam power supply on removal of right side cover
3S8	Interior, middle rear, left edge of amplifier cabinet	Beam power supply on removal of left rear cover
3S9	Interior, middle rear, right edge of amplifier cabinet	Beam power supply on removal of right rear cover

SECTION II
OPERATING INSTRUCTIONS

3-7. GENERAL.

3-8. Indicator lamps on and in the equipments provide the operator with information concerning the state of the 10-kw power amplifier during operation. The indicator lamps are white, amber, or red. White indicator lamps signify the application of internal and external ac power. Amber indicator lamps light when a malfunction exists in a particular circuit or when the associated circuit breaker has been opened. The small red panel indicator lamp indicates the application of beam power to the klystron tube. Two large red indicator lamps located inside the amplifier cabinet light when a cabinet interlock is bypassed.

3-9. The following procedures assume that the 10-kw power amplifier is installed properly and that all piping and wiring has been checked and found to be in accordance with the installation plans. It is also assumed that power, which meets the electrical requirements for the 10-kw power amplifier, is available and is supplied to the equipment. (Refer to the table of leading particulars in Chapter 1.)

3-10. The operating procedures given in this chapter are to be followed only if the equipment has been operating normally prior to a shut-down period not exceeding one hour, and no adjustment or tuning control settings have been changed. If the equipment has been shut down more than one hour, the alignment and adjustment procedures given in Chapter 5 must be performed prior to operation.

3-11. STARTING PROCEDURES.

3-12. When the previously tuned and operating 10-kw power amplifier is to be energized after a brief shut-down period not exceeding one hour, the starting procedures are as follows.

3-13. PRELIMINARY OPERATING INSTRUCTIONS.

CAUTION

The following checks and control settings must be made prior to turning on the 10-kw power amplifier.

a. Check that all panels and doors are secured properly.

b. Check that adjustments and tuning control settings have not been changed during the shut-down period.

CAUTION

Damage to the klystron is possible if control settings have been changed during shut down and the 10-kw power amplifier is turned on using the following procedure.

c. Check that the input rf signal level and frequency have not been changed during the shut-down period.

d. Set the RESET-NORMAL-AUTOMATIC switch on the ac control panel to AUTOMATIC.

e. Operate the controls on the associated heat exchanger for remote turn on in accordance with the instructions given in the applicable technical manual.

NOTE

The 10-kw power amplifier is normally used in conjunction with Cooler, Liquid, Electron Tube (heat exchanger) either HD-431/FRC-39A(V) or HD-661/FRC-39A(V)7, TM 11-5820-750-15.

3-14. TURN ON PROCEDURE.

WARNING

Approximately 17,000 volts are present when the 10-kw power amplifier is energized. Be very careful when working around the equipment.

Make certain that all power is disconnected and that the high voltage circuits are grounded before entering the amplifier cabinet. Discharge filter capacitors and ground all exposed terminals with the grounding rods provided in the cabinet. At least two men, thoroughly trained in the procedures used in treating electric shock, are required when servicing the equipment.

3-15. To turn on the 10-kw power amplifier proceed as follows:

a. Set the MAIN POWER circuit breaker on the distribution panel to ON. The MAIN PWR ON indicator lamp on the 10-kw power amplifier cabinet should light.

b. Operate the SHUT DOWN circuit breaker on the ac control panel to ON and observe that the SHUT DOWN indicator lamp on the ac control panel goes off.

c. Operate the HEAT EXCHANGER switch on the ac control panel to ON and observe that the HEAT EXCH ON indicator lamp on the 10-kw power amplifier cabinet goes on. The KLYSTRON COOLANT FLOW gauge on the klystron carriage should indicate a minimum flow of 18 gallons per minute.

d. Operate the CABINET AIR COOLING PWR circuit breaker on the ac control panel to ON and observe that the CABINET AIR COOLING PWR indicator lamp on the ac control panel goes off. The CIRCULATION FAN ON indicator lamp on the 10-kw power amplifier cabinet should go on.

e. Operate the KLYSTRON AIR COOLING PWR circuit breaker on the ac control panel to ON and observe that the CARRIAGE AIR COOLING ON indicator lamp on the 10-kw power amplifier cabinet goes on.

f. Operate the REGULATED POWER circuit breaker on the ac control panel to ON and observe that the SINGLE PHASE REG ON indicator lamp on the 10-kw power amplifier cabinet goes on.

g. Operate the POWER circuit breaker on the 120-volt regulator control panel to ON and observe that the POWER indicator lamp on the 120-volt regulator control panel goes off.

h. Operate the POWER circuit breaker on the field coils regulator control panel to ON and observe that the POWER indicator lamp on the field coils regulator control panel goes off.

i. Operate the POWER circuit breaker on the beam regulator control panel to ON and observe that the POWER indicator lamp on the beam regulator control panel goes off.

j. Operate the FIL PWR and FIL POWER circuit breakers on the ac control panel to ON and observe that the FIL POWER indicator lamp on the ac control panel and the FILAMENT CKT ON indicator lamp on the 10-kw power amplifier cabinet go on.

k. Slowly rotate the KLYSTRON FIL VOLTS ADJUST control on the ac control panel in the clockwise direction until the KLYSTRON FIL VOLTS meter on the ac control panel indicates 7.5 volts.

NOTE

Observe that the FILAMENT CKT ON indicator lamp goes on when approximately 3.5 volts is indicated on the KLYSTRON FIL VOLTS meter. Also observe that the BEAM T.D. OVER indicator lamp on the 10-kw power amplifier cabinet goes on after 5 minutes.

l. Operate the LINE VOLTS switch on the ac control panel to REG/UNREG. The LINE VOLTS meter on the ac control panel should indicate 120 volts ac.

m. Operate the FIELD COILS POWER circuit breaker on the ac control panel to ON and observe the FIELD COILS POWER indicator lamp on the ac control panel goes off. The FIELD COILS CURRENT meter on the meter panel should indicate three amperes.

n. Operate the PREFOCUS COIL PWR circuit breaker on the ac control panel to ON and

observe that the PREFOCUS COIL PWR indicator lamp on the ac control panel goes on. The INTERLOCKS CLOSED indicator lamp on the amplifier cabinet should go on.

o. Operate the ALARM POWER and GETTER POWER breakers on the ac control panel to ON and observe that the ALARM POWER and the GETTER POWER indicator lamps on the ac control panel go off.

p. Operate the BEAM AC OVERLOAD and BEAM POWER circuit breakers on the distribution panel to ON.

q. Press the BEAM VOLTAGE ON pushbutton switch on the klystron carriage. The BEAM ON indicator lamp on the amplifier cabinet should go on, indicating that the 10-kw power amplifier is now operating normally.

r. Turn the BEAM VOLTAGE ADJUST control on the distribution panel clockwise until the indication on the BEAM VOLTS meter on the meter panel is 17 kv.

s. Turn the 3RD CAVITY TUNING control approximately four complete turns in the counterclockwise direction. Observe for a maximum indication on the OUTPUT FORWARD meter on the klystron carriage and a rise in body current on the BODY CURRENT meter on the meter panel.

t. Adjust the 3RD CAVITY TUNING control to minimize body current without causing a loss in the output power as indicated on the OUTPUT FORWARD meter on the klystron carriage. The OUTPUT FORWARD meter should have an indication of between 9 and 11 kw.

3-16. TURN OFF PROCEDURES.

3-17. NORMAL TURN OFF PROCEDURE.

3-18. To totally shut down the 10-kw power amplifier, perform the following procecures:

a. Turn the BEAM VOLTAGE ADJUST control on the klystron carriage counterclockwise until the indication on the BEAM VOLTS meter on the meter panel decreases to 10 kv.

b. Turn the 3RD CAVITY TUNING control on the klystron carriage four complete turns in the clockwise direction.

c. Turn the KLYSTRON FIL VOLTS ADJUST control on the ac control panel counterclockwise until the indication on the KLYSTRON FIL VOLTS meter on the ac control panel is 6 volts.

d. Press the BEAM VOLTAGE OFF pushbutton switch on the klystron carriage.

e. Operate the SHUT DOWN circuit breaker on the ac control panel to OFF.

f. Wait approximately 5 minutes for the fans and cooling system to turn off.

g. Operate the MAIN POWER circuit breaker on the distribution panel to OFF.

h. Operate the remaining circuit breakers on the 10-kw power amplifier to OFF. All indicator lamps should be extinguished.

i. Turn the KLYSTRON FIL VOLTS ADJUST control on the ac control panel completely counterclockwise.

j. Turn off the associated heat exchanger in accordance with the instructions given in the applicable technical manual.

3-19. EMERGENCY TURN OFF PROCEDURE.

CAUTION

The emergency turn off procedure shall be used in an extreme emergency only, as this procedure will cause the cooling system to stop immediately, with possible resultant damage to the klystron tube.

3-20. In the event of an emergency, turn off the 10-kw power amplifier completely by setting the MAIN POWER circuit breaker on the distribution panel to OFF.

SECTION III
EMERGENCY OPERATION

NOT APPLICABLE

CHAPTER 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION. This chapter contains information on the principles of operation of the 10-kw power amplifier. Section I of this chapter contains brief, functional descriptions of the 10-kw power amplifier. Section II describes the functional operation of the electronic circuits in detail. Section III describes operation of the mechanical and electromechanical components. In order to follow the discussions in Section II fully, you should refer to the detailed schematics in chapter 6 of this manual.

Block diagrams and simplified schematics, which supplement the circuit diagrams, are included as an aid in understanding the discussions.

SECTION I
FUNCTIONAL SYSTEM OPERATION

4-2. GENERAL DESCRIPTION.

4-3. The 10-kw power amplifier (fig. 4-1) is functionally comprised of the rf system, ac power distribution system, power supply system, ac regulator system, protective and alarm system, and the cooling system. The rf system performs the primary function of application. The ac power distribution system provides ac power, in the proper sequence, to the various circuits of the 10-kw power amplifier, and terminates the 10-kw power amplifier's operation in the event of a malfunction. The power supply system provides the dc and low voltage ac voltages necessary for the rf system. The ac regulator system regulates operating voltages in various power amplifier circuits. The protective and alarm system is a series of visual alarms that indicate malfunctions in the other systems. The cooling system removes the heat generated by the 10-kw power amplifier. Each of the systems are further broken down into the circuits discussed in the following paragraphs.

4-4. RF SYSTEM.

4-5. The rf system provides the circuitry necessary for the amplification and monitoring of the rf drive signal from the exciter. Figure 4-2 shows a functional block diagram of the rf system.

4-6. The rf input from the exciter is applied to the klystron tube by way of the rf input circuitry. The klystron tube amplifies the signal to 10 kw, which is supplied to the antenna system for transmission or to a dummy load for calibration.

4-7. The rf input circuitry provides input impedance matching and a means for sampling and monitoring the input rf power. The prefocus and field coils keep the electron beam centered in the klystron tube during the process of amplification. Loads and calibration meters are provided in the cavity load and metering circuit for each cavity of the klystron tube.

4-8. AC POWER DISTRIBUTION SYSTEM.

4-9. The ac power distribution system in the 10-kw power amplifier provides a sequence of application of ac power to the various systems that make up the 10-kw power amplifier.

4-10. The ac power distribution circuitry consists of time-delay relays, hold-in relays, cheatable interlock switches, air-flow switches, liquid-flow switches, and circuit breakers. These switches and relays are connected in such a way as to shut down the 10-kw power amplifier whenever there is an overload condition, a malfunction in the associated heat exchanger,

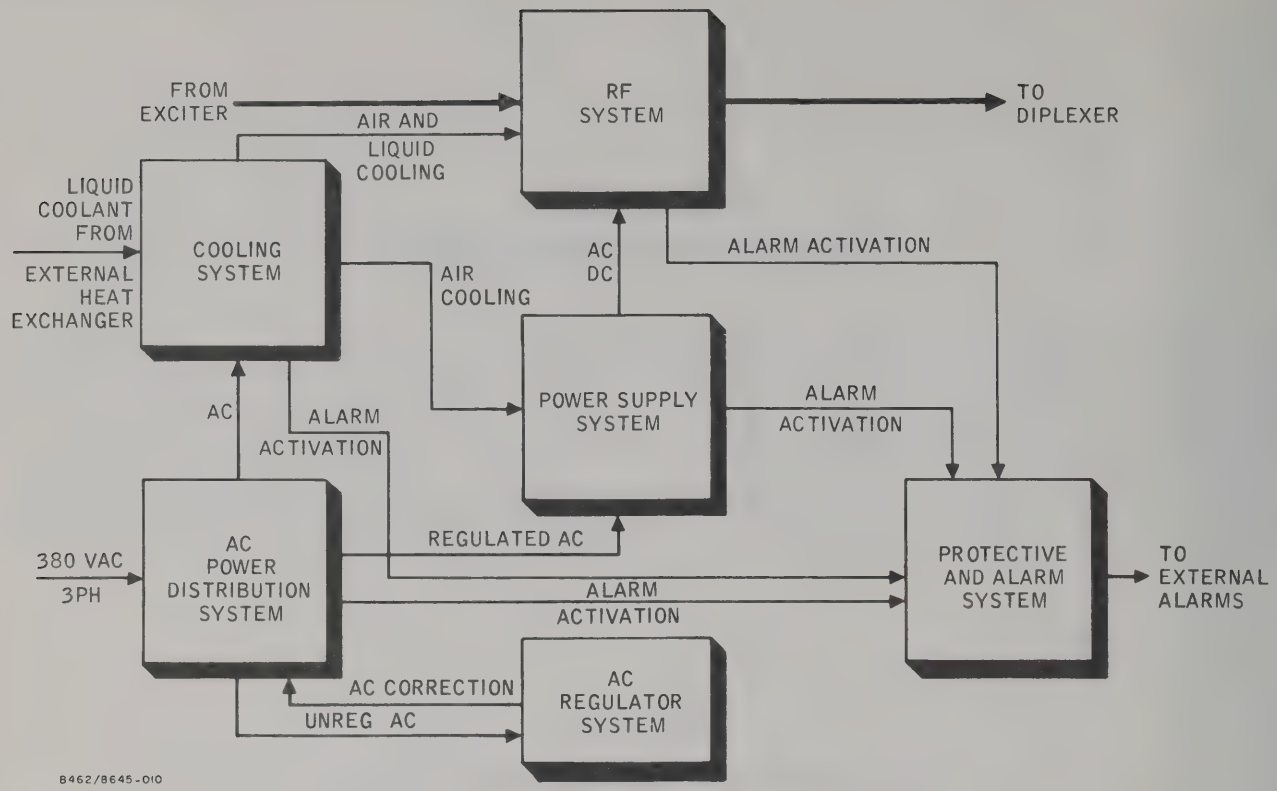

Figure 4-1. 10-kw Power Amplifier, Functional Block Diagram

a malfunction in the rf system, loss of air flow from the klystron blower, and whenever any panel is removed from the 10-kw power amplifier. The time-delay relays ensure proper sequence of application of ac power to the systems that comprise the 10-kw power amplifier. The hold-in relays expedite the return of ac power to the 10-kw amplifier after interruptions of ac power of 2.5 seconds or less.

4-11. The ac power distribution system applies ac power to the circuits within the various systems that comprise the 10-kw power amplifier in the following order; cooling circuits; filament circuits; beam power circuits.

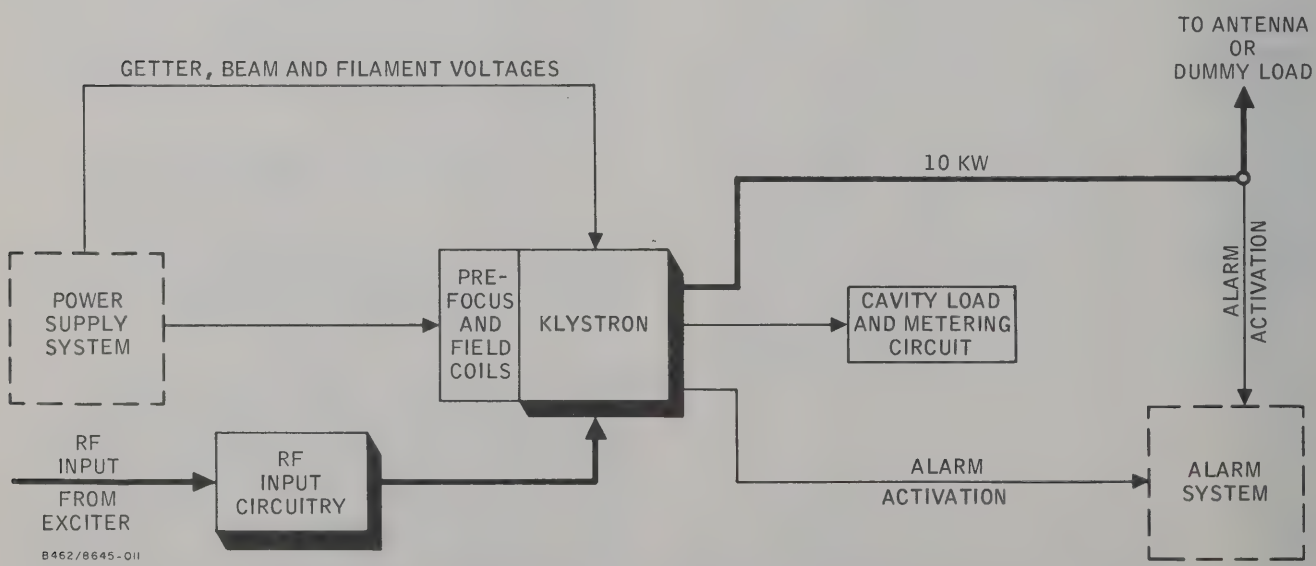

Figure 4-2. RF System Functional Block Diagram

4-12. POWER SUPPLY SYSTEM.

4-13. The power supply system provides the dc and low amplitude ac voltages necessary for the operation of the 10-kw power amplifier. All dc voltages referred to in the following paragraphs are referenced to chassis ground. All ac voltages are referenced to the neutral line. Figure 4-3 shows a functional block diagram of the power supply system which is broken down into the following subsystems: prefocus coil power supply, the field coils power supply, getter power supply, beam power supply, and the filament power supply.

4-14. PREFOCUS AND FIELD COILS POWER SUPPLIES.

4-15. The prefocus and field coils power supplies provide the voltage necessary to energize the electromagnetic coils surrounding the klystron tube. The prefocus coil power supply provides a maximum of 30 volts dc while the field coils power supply provides a maximum of 400 volts dc. The voltages are adjustable to permit variation of the field strengths along the length of the klystron tube.

4-16. GETTER POWER SUPPLY.

4-17. The getter power supply furnishes 2 or 4 volts ac to the getter within the klystron tube. The getter maintains the vacuum of the klystron tube at the level required for efficient operation and maximum tube life.

4-18. BEAM POWER SUPPLY.

4-19. The beam power supply provides approximately -17,000 volts dc for the operation of the klystron tube. This voltage accelerates the electron beam between the klystron tube cathode

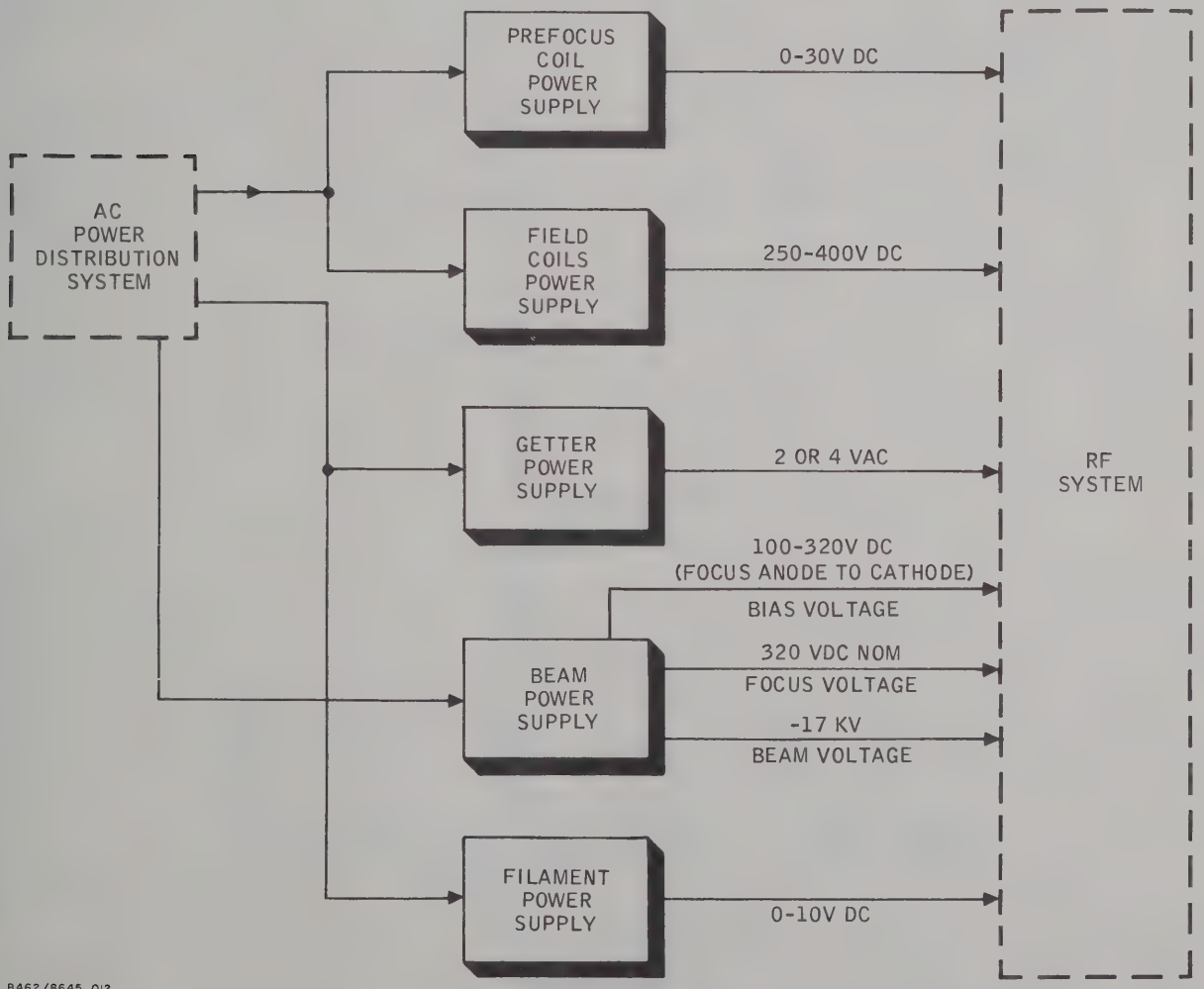

Figure 4-3. Power Supply System, Functional Block Diagram

and collector. A portion of the beam power supply output is used as klystron tube cathode bias voltage. This bias voltage allows the cathode to be positive (100-320 vdc) with respect to the focus anode.

4-20. FILAMENT POWER SUPPLY.

4-21. The filament power supply furnishes an adjustable ac voltage of between zero and 10 volts ac to the filament of the klystron tube. The voltage is normally maintained at 7.5 vac.

4-22. AC REGULATOR SYSTEM.

4-23. The ac regulator system consists of a beam voltage regulator circuit, a field coils regulator circuit, and a 120-volt regulator circuit. The beam voltage regulator circuit regulates the ac voltage applied to the beam power supply. The field coils regulator circuit regulates the ac voltage applied to the field coils power supply; and the 120-volt regulator circuit regulates the ac voltage applied to the filament, prefocus coil and getter power supplies. In addition the 120-volt regulator circuit is capable of supplying 120 volts regulated ac for use external to the 10-kw power amplifier, typically as the ac power source for an exciter and two receivers. All three regulator circuits are similiar in operation. Figure 4-4 shows a typical block diagram for either the beam voltage regulator circuit or the 120-volt regulator circuit.

4-24. The typical voltage regulator circuit consists of an autotransformer, a bridge power supply, a balanced bridge, raise-lower relays, and a control motor.

4-25. The sample voltage supplied to the regulator circuits is used as both operating voltage and sensing voltage. The sample voltage is rectified and filtered by the bridge power supply and sensed in the balanced bridge circuit. When the balanced bridge becomes unbalanced, due to a change in the ac input power, the raise-lower relays activate the control meter. The control motor changes the primary-to-secondary windings ratio in the autotransformer, thus regulating the output voltage from the autotransformer.

4-26. The field coils regulator circuit operates in a manner similar to the other two regulator circuits except that it contains no bridge power supply. It obtains its dc sensing voltage from the field coils power supply.

4-27. PROTECTIVE AND ALARM SYSTEM.

4-28. The protective and alarm system utilized in the 10-kw power amplifier monitors the klys-

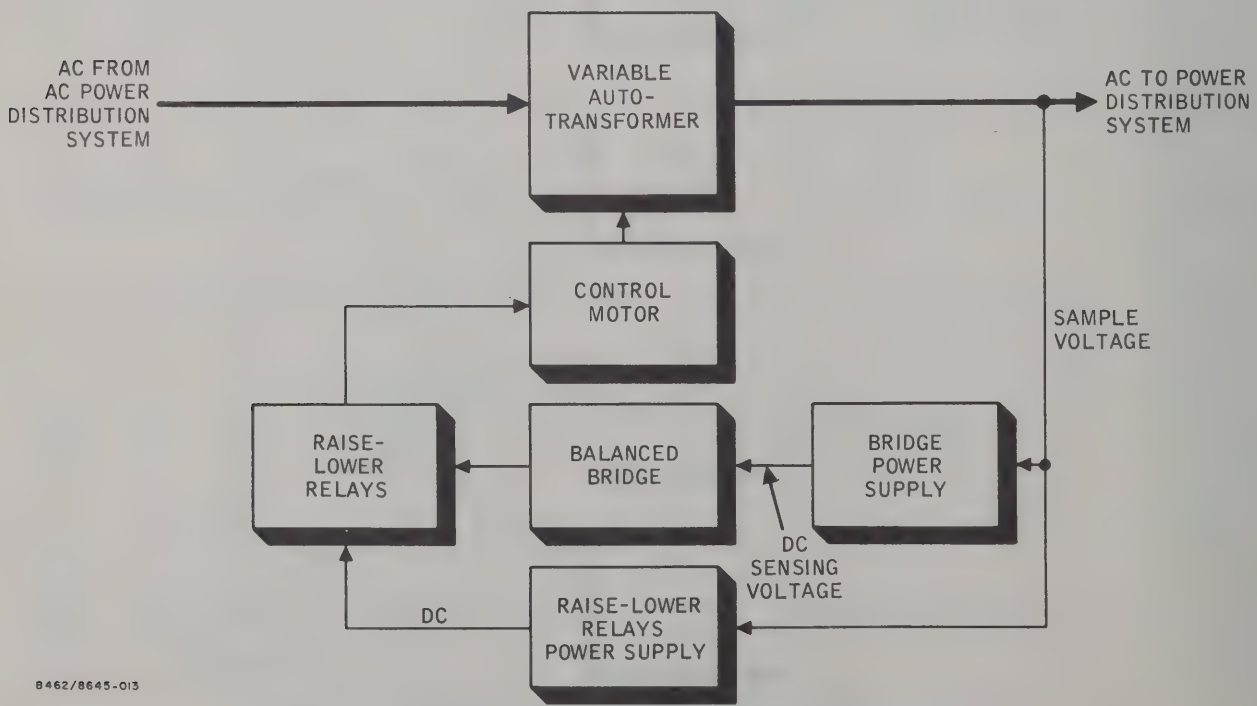

Figure 4-4. AC Regulator System, Functional Block Diagram

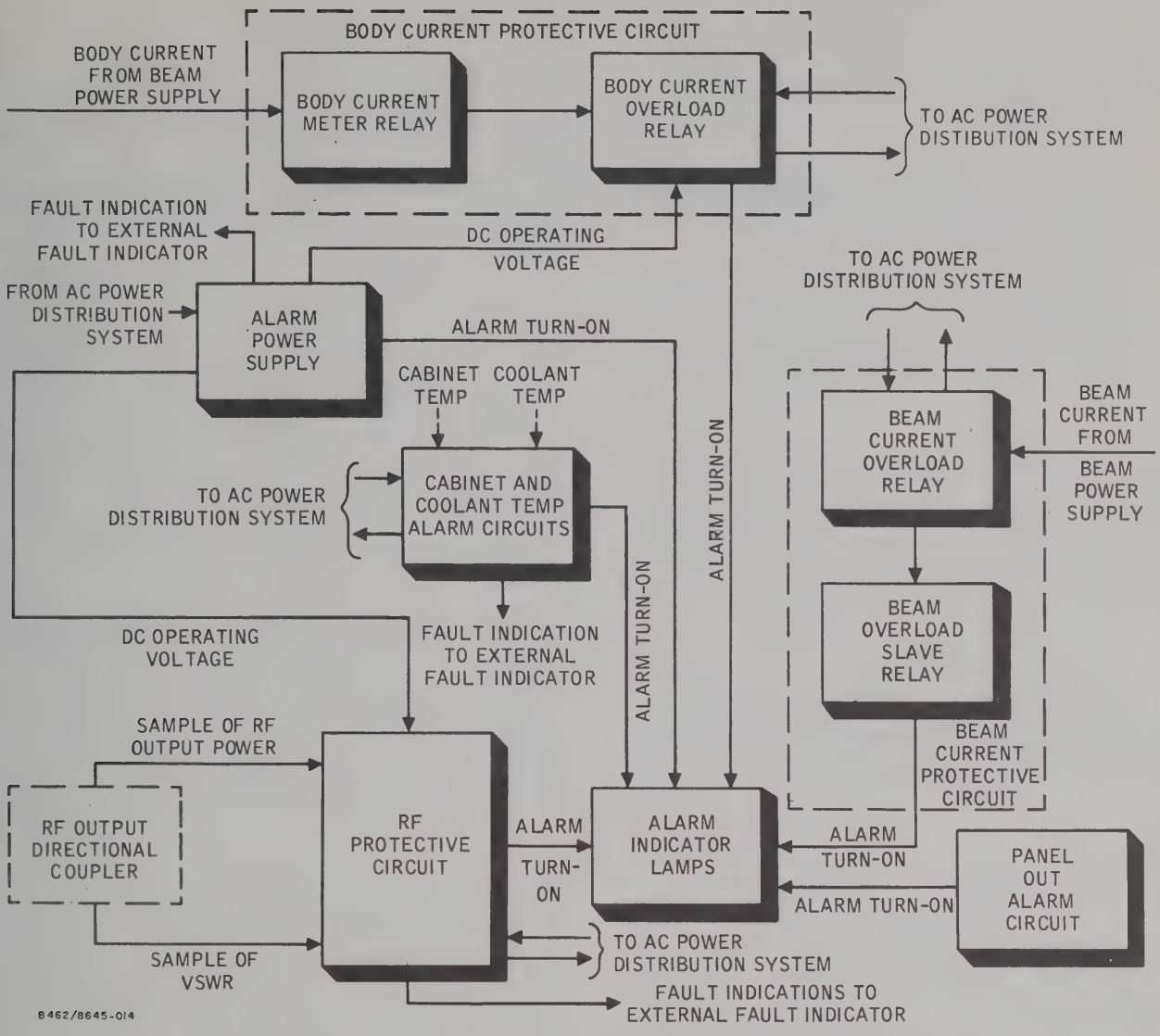

Figure 4-5. Protective and Alarm System, Functional Block Diagram

tron body current, the klystron beam current, and the output forward and reflected power (vswr) sampled from the rf output directional coupler (see fig. 4-5). The protective and alarm system consists of alarm indicator lamps, an rf protective circuit, a body current protective circuit, a beam current protective circuit, a cabinet temperature alarm circuit, a coolant temperature alarm circuit, a panel out alarm circuit, and an alarm power supply.

4-29. The rf protective circuit causes ac power to be removed from the beam power supply and activates an alarm indicator lamp in the event of abnormal rf power.

4-30. The body current protective circuit monitors the klystron body current, opens the ac power distribution system, and turns on an alarm indicator lamp when the klystron body current exceeds a preset value.

4-31. The beam current protective circuit monitors the klystron beam current and opens the ac power distribution system when the klystron beam current exceeds a preset value. In addition the beam current overload relay activates a beam overload slave relay which turns on an alarm indicator lamp. This alarm will continue until the beam current overload relay is reset.

4-32. The cabinet temperature alarm circuit and the coolant temperature alarm circuit monitor the temperature of the cabinet air and temperature of the liquid coolant respectively. They turn on associated alarm indicator lamps in the event of high temperature. In addition the coolant temperature alarm circuit opens the

ac power distribution system when the coolant temperature rises 3°C (5°F) higher than the temperature which caused the alarm indicator lamp to come on.

4-33. The panel out alarm circuit causes an alarm indicator lamp to come on whenever any of the following panels are disconnected: 3A3A1, 3A3A2, 3A3A3, and 3A3A4.

4-34. The various circuits of the protective and alarm system also contain relay circuitry which provide fault indications to an external fault indicator.

4-35. The alarm power supply furnishes the dc operating voltage necessary to operate the relays in the protective and alarm system. The alarm power supply also has a fault indicating circuit which will activate an alarm indicator lamp whenever the alarm power supply fails.

4-36. COOLING SYSTEM.

4-37. The cooling system provides a means for removing the heat generated by the 10-kw power amplifier. Cooling is accomplished by two methods; air and liquid.

4-38. LIQUID COOLING.

4-39. Liquid coolant from an external heat exchanger is pumped through hydraulic lines to the 10-kw power amplifier where it is circulated through the structure of the klystron tube to absorb its heat energy. The heated coolant from the klystron tube is returned to the heat exchanger, cooled, and recirculated in the 10-kw power amplifier.

4-40. AIR COOLING

4-41. Air cooling of the 10-kw power amplifier is provided by five fans and a blower. Two fans are mounted on the distribution panel, the third is located on the cabinet partition above the klystron carriage. The remaining two fans are located on the klystron carriage, one on the left side and the other on the bottom under the cavity loads. The blower is located on the lower rear of the klystron carriage.

4-42. In addition to the fans and blower, air cooling is also accomplished by an automatic damper located on the right rear top of the 10-kw power amplifier. When the temperature rises slats of the automatic damper open, allowing overheated air to escape, thus increasing the interior air circulation.

SECTION II
FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

4-43. RF SYSTEM.

4-44. RF INPUT CIRCUITRY.

4-45. The rf input circuitry (fig. 4-6) provides the components required for input impedance matching and input power monitoring.

4-46. The rf input from the exciter is connected to the 10-kw power amplifier through an adjustable telescopic transmission line tubing, line stretcher 3W56. The line stretcher is primarily used to match the impedance phase angle of the exciter by adjusting transmission line length without introducing impedance mismatch. It compensates for impedance irregularities in the exciter output and transmission lines and fittings. Adjustment of the line length is made by a movable slider, LINE STRETCHER ADJUST control, contained within the unit. This line stretcher was added by REL modification 57.

4-47. The rf input power from the line stretcher is applied to the first cavity of the klystron tube by way of rf input directional coupler 3A1DC1 which samples the forward and back power; and input cavity 3A1A125, which is a tunable bandpass filter that eliminates undesired harmonics.

4-48. The sample input forward power is rectified by diode 3A1CR1, filtered by capacitors 3A1C8 and 3A1C18, and applied to INPUT FORWARD-1ST CAVITY LOAD meter 3A1M1 through calibrating (CAL) resistor 3A1R1 and INPUT FORWARD-1ST CAVITY LOAD switch 3A1S1. With the INPUT FORWARD-1ST CAVITY LOAD switch in the 1ST CAVITY LOAD position the INPUT FORWARD-1ST CAVITY LOAD meter monitors the 1st cavity load rectified sample voltage (see para 4-76).

4-49. The sample input back power is rectified by diode 3A1CR3, filtered by capacitors 3A1C9 and 3A1C19, and applied to the INPUT BACK POWER meter through series protection resistor 3A1R14 and TUNE-FS 2 WATTS switch in the TUNE position. The TUNE position is utilized during rough initial tuning so that the meter may be protected by the series resistor. The FS 2 WATTS position, whereby calibration resistor (INPUT BACK CAL) 3A1R3 is connected in series with the meter, is used under normal operating conditions.

4-50. KLYSTRON.

4-51. GENERAL. Because the klystron is the most important component of the 10-kw power amplifier, it is necessary that you have a clear understanding of the basic theory of a klystron amplifier.

4-52. An understanding of klystron operation and the important factors which influence klystron characteristics involves several concepts which differ from the more familiar ideas of ordinary radio practice. These concepts may often be analyzed with analogies to vacuum tube circuits.

4-53. The klystron is not as mysterious as it may seem to persons accustomed to using conventional tubes, even through it has no grid and no plate and there are no lumped tuned circuits connected to it by means of wires leading out of the tube. Actually, the klystron is a simple device which exists for the same reason that conventional negative-grid tubes exist; that is, it controls the behavior of electron streams flowing in a vacuum. The great difference between the klystron and the conventional tube lies not in what it does, but in how it does it.

4-54. Conventional triode or multigrid tubes, in which the electron flow is controlled by a potential field surrounding the grids, have upper usable frequency limits beyond which the electrons cannot respond efficiently to the alternating control voltages applied to the grids. This occurs when the time required by the electrons for the transit of their paths becomes a substantial part of the period of one cycle at the operating frequency.

4-55. As a result of transit time effects, efforts to obtain satisfactory operating of conventional tubes at the higher frequencies have resulted in the development of extremely small tubes in

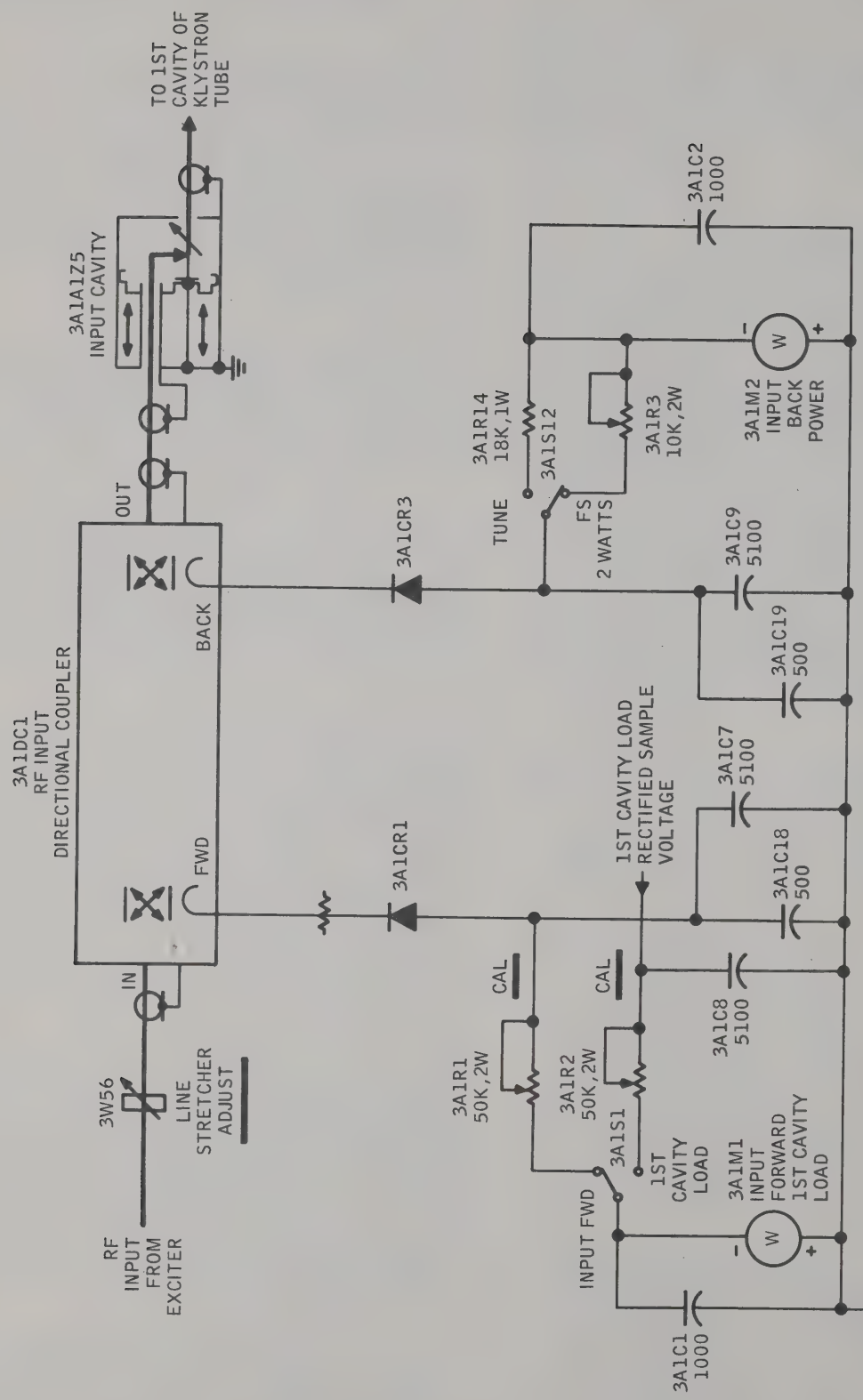

Figure 4-6. RF Input Circuitry, Simplified Schematic Diagram

which the lengths of the electron paths are reduced to the practical minimum. Such tubes are extensively used in low-power applications, but they are simply too small to control great amounts of power.

4-56. On the other hand, klystrons must be relatively large in order to take advantage of transit time effects, which are essential to their operation. The klystron used in the 10-kw power amplifier provides at least 10 kw of continuous power in the 850-mc region.

4-57. A typical klystron (fig. 4-7) can be divided into three functional sections: the electron gun, the rf section, and the collector.

4-58. THE ELECTRON GUN. The electron gun is the source of the electron beam upon which the operation of the klystron depends (see fig. 4-8). The difference of potential between the cathode and the anode (approximately 17 kv) causes the electrons to flow away from the cathode toward the anode. The electrons are emitted from a heated cathode and flow along a converging path due to the fields set up by the focus electrode.

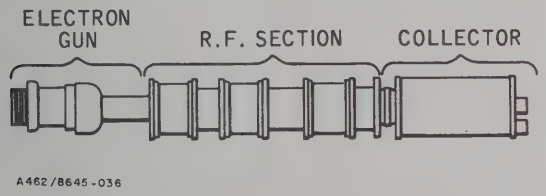

Figure 4-7. Typical Externally Tuned Klystron

4-59. The electrons exert mutually repellent forces on each other and these forces tend to spread the beam. To counteract this force, variable focus magnets are utilized. These direct and concentrate the beam along the beam axis and keep the beam sharply focused down the length of the drift tube.

4-60. RF SECTION. The rf section of the klystron is made up of the drift tube and four resonant cavities which surround it at intervals along its length. The drift tube is axial and has gaps along its length. A resonant cavity is constructed around each drift tube gap (see fig. 4-9). The drift tube tips, therefore, become the capacitive loading elements in the cavity, and rf voltages will be induced across them when the cavity is excited at resonance.

4-61. COLLECTOR. The electron beam transfers most of its energy to the rf circuits as it flows through the rf section, and it carries the balance of its energy out of the rf section into the collector.

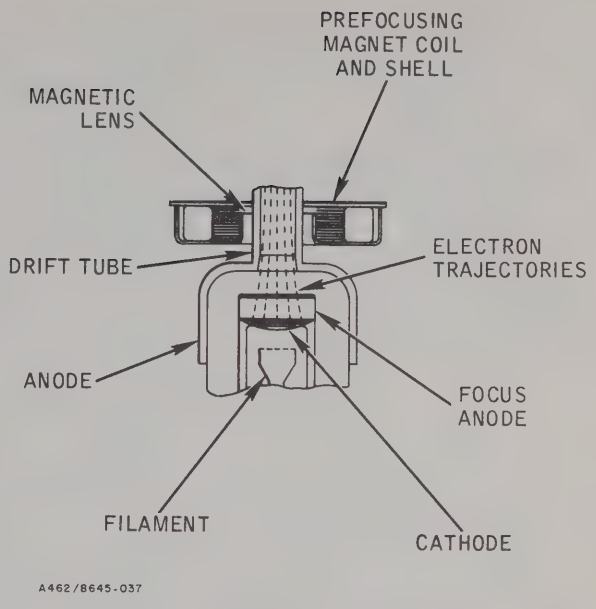

Figure 4-8. Simplified View of Electron Gun

4-62. THE ELECTRON BEAM. Upon leaving the electron gun and entering the drift tube, the electron beam is a continuous stream moving at constant velocity. This direct-current electron beam cannot produce rf power as it flows through the klystron.

4-63. The signal from the input cavity is inductively coupled into the 1st cavity, exciting the cavity, which is tuned to resonate near the input frequency. The oscillations that occur in the 1st cavity, due to the input signal and the fact that it is tuned to resonate near this frequency, provide a rf alternating field across the first drift tube gap (refer to figs. 4-9 and 4-10).

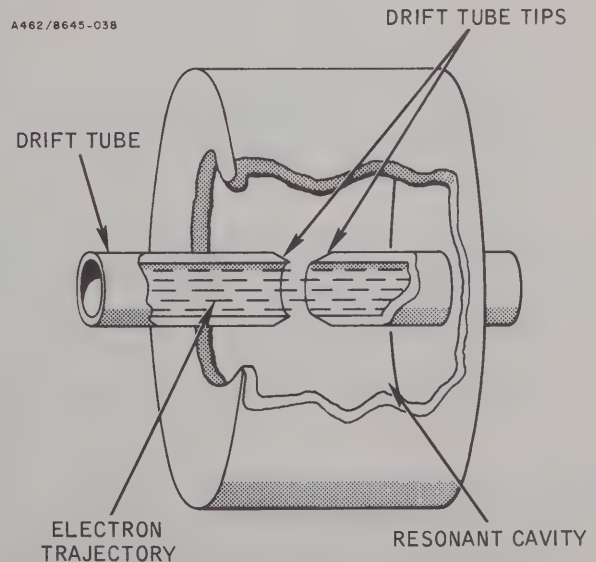

Figure 4-9. Simplified View of Drift Tube Cavity

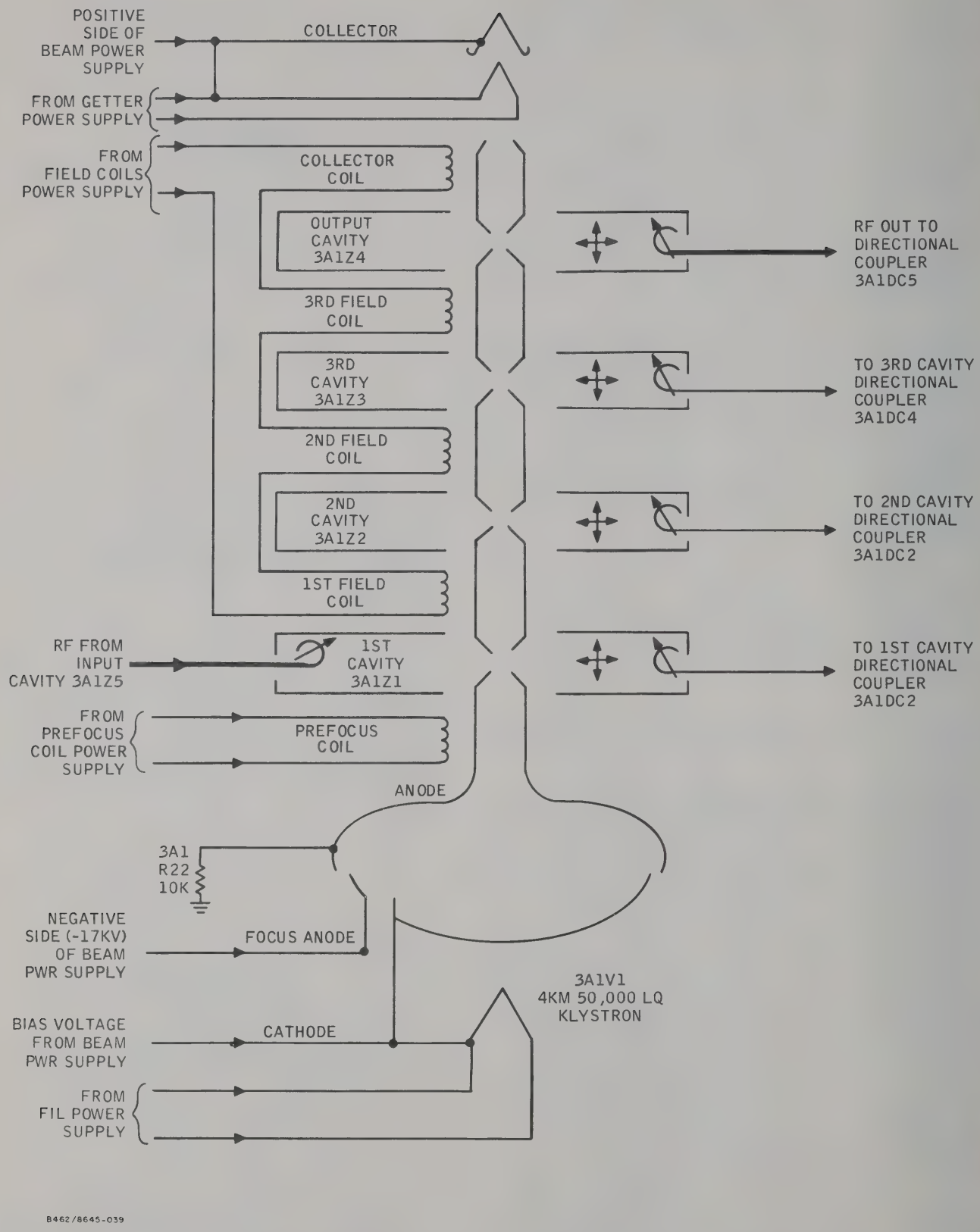

Figure 4-10. Klystron Tube Simplified Schematic Diagram

4-64. The rf alternating field produces an alternating voltage across the tips of the drift tube gap (capacitive element). Those electrons, in the parts of the beam passing the gap when it is positively polarized flowing from a region of negative charge toward a region of positive charge, experience an increase in velocity due to the repulsion of like charges on the tip closest to the cathode and the attraction of unlike charges on the tip closest to the collector.

4-65. Conversely, the electrons in that part of the beam passing through the first drift tube gap during the half cycles of negative polarity travel from a positive to a negative region. As a result, they lose velocity due to the attraction of unlike charges on the tip closest to the cathode and the repulsion of like charges on the tip closest to the collector.

4-66. The beam leaving the first gap is continuous and of uniform density, but alternate parts along its length contain electrons having higher or lower velocities than they had before entering the gap. The faster electrons begin to overtake the slower electrons as the beam travels freely down the axis of the drift tube, until at some point a few inches from the gap the fastest electrons will be traveling in company with slowest electrons for a brief period.

4-67. This formation of electron "bunches" is called density modulation and is a direct result of the initial velocity modulation. One bunch is formed for each complete rf cycle. The length of the drift tube is chosen so that the bunch is formed as it enters the second cavity. The resultant oscillations and their electric fields develop an alternating voltage across the next gap which velocity-modulates the beam in the same manner as the previous cavity, except that the level of velocity modulation is higher. The resulting density modulation of the beam is greater and thus, the next cavity along the line receives an even larger driving pulse and produces a larger modulating voltage. This process is repeated in the 3rd, and output cavities.

4-68. In the output cavity, the energy from the bunched beam is inductively coupled to the load (antenna or dummy load) through directional coupler DC5. In this manner, power amplification is produced.

4-69. As previously mentioned, one bunch is formed for each complete rf cycle. The frequency of the arrival of bunches into the output cavity varies, therefore, in accordance with the input signal, including any frequency modulation intelligence.

4-70. BODY CURRENT. The entire electron beam does not reach the collector. Some of the electrons strike the tube walls and are lost in spite of focusing. The current caused by the electrons striking the tube walls is called the body current. When the body current is excessive, as a result of poor focusing or improper voltages applied, it causes excessive heating and damage to the klystron.

4-71. PREFOCUS AND FIELD COILS.

4-72. The magnetic field which guides the electron beam in the klystron is created by controlled amounts of direct current flowing in electromagnet coils surrounding the klystron (see fig. 4-10). These are the prefocus coil; the 1st, 2nd, and 3rd field coils; and the collector coil. The purpose of the magnetic field is to control the diameter and direction of the electron beam as it flows through the klystron, so that as little beam current as possible will strike the drift tube walls and be wasted.

4-73. The prefocus coil overcomes the tendency of the electron paths in the beam to diverge and strike the drift tube wall before the beam enters the magnetic field of the field coils. It is located on the drift tube between the anode and the 1st cavity.

4-74. The three field coils, located between the cavities of the klystron, focus the electron beam and maintain it in the center of the drift tube.

4-75. The collector coil surrounds the klystron's collector. It serves to establish the magnetic field needed near the collector end of the drift tube.

4-76. The voltage necessary to energize these coils is provided by the prefocus coil power supply and the field coils power supply. These power supplies will be discussed in detail in later paragraphs of this chapter.

4-77. CAVITY LOAD AND METERING CIRCUIT.

4-78. The cavity load and metering circuit (fig. 4-11) provides the resistive loads and calibration meter circuitry required for alignment of the klystron cavities.

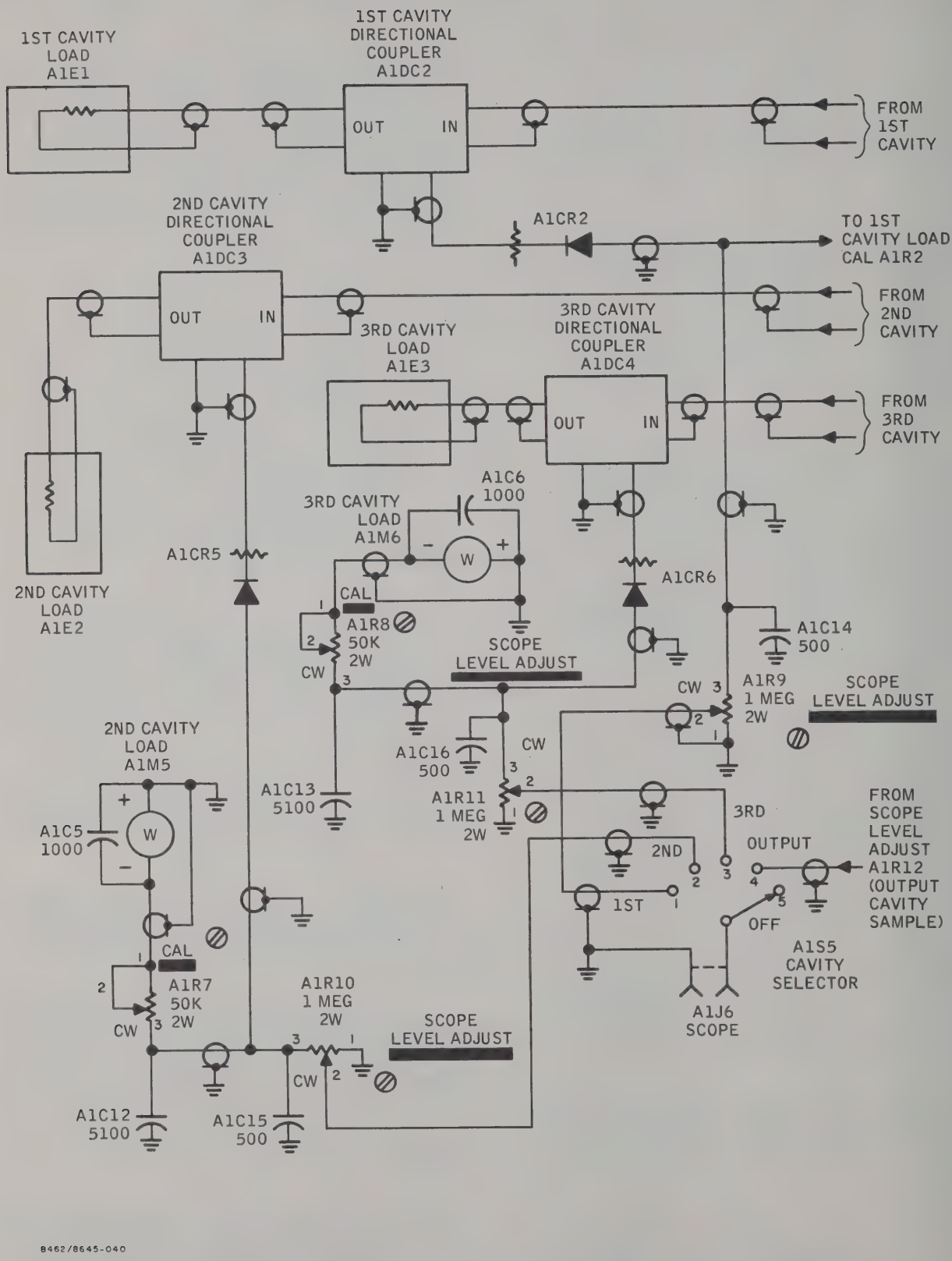

Figure 4-11. Cavity Load and Metering Circuit Simplified Schematic Diagram

4-79. The 1st cavity is connected to 1st cavity directional coupler 3A1DC2. The directional coupler applies the signal to 1st cavity load 3A1E1 and also supplies a sample of this signal for monitoring the power applied to the load. The sample voltage is rectified by diode 3A1CR2 and applied to the INPUT FORWARD-1ST CAVITY LOAD meter for monitoring, V12 the 1ST CAVITY LOAD CAL variable resistor and the INPUT FORWARD-1ST CAVITY LOAD switch (fig. 4-6).

4-80. A portion of the rf power in the 2nd and 3rd cavities (fig. 4-11) is coupled through directional couplers 3A1DC3 and 3A1DC4 to cavity loads 3A1E2 and 3A1E3 respectively. A sample of the 2nd cavity rf power is obtained from directional coupler 3A1DC3, rectified by diode 3A1CR5 and applied to 2ND CAVITY LOAD meter 3A1M5 through series calibrating variable resistor 2ND CAVITY LOAD CAL control 3A1R7. A sample of the 3rd cavity rf power is obtained from directional coupler 3A1DC4, rectified by diode 3A1CR6 and applied to 3RD CAVITY LOAD meter 3A1M6 through series calibrating variable resistor 3RD CAVITY LOAD CAL control 3A1R8.

4-81. The rectified cavity rf power samples can also be observed on an external oscilloscope or meter at SCOPE jack 3A1J6. The cavity to be monitored is selected by CAVITY SELECTOR switch 3A1S5. The level of the samples can be adjusted by SCOPE LEVEL ADJUST variable resistors 3A1R9 through 3A1R12.

4-82. AC POWER DISTRIBUTION SYSTEM.

4-83. The following discussion of the theory of operation of the ac power distribution system in the 10-kw power amplifier assumes that all the circuit breakers are in the ON position and all interlock switches are making contact. It is also assumed that RESET-NORMAL-AUTOMATIC switch 3A3S6 is in the NORMAL position.

4-84. Interlock switches 3S3 through 3S9, with the exception of 3S5 are cheatable. Indicator lamps 3DS12 and 3DS13 light when the interlock switches are cheated. Filament switch 3A3S1 is controlled by the position of the cam that is connected to variable autotransformer 3A3T1.

4-85. Refer to the cross-the-line ac power distribution diagram in chapter 6 of this manual while reading the following text. The simplified schematics contained in this section supplement the ac across-the-line diagram.

4-86. SEQUENCE OF APPLICATION OF AC POWER.

4-87. The 208-volt ac, 3-phase power enters the 10-kw power amplifier on terminals A, B, and C of terminal board TB2. Terminal N is the neutral connection. The ac power passes through MAIN POWER circuit breaker 3A2CB1 to the line voltage metering circuit. THREE PHASE PWR ON 3DS1, SINGLE PHASE PWR ON 3DS2, and MAIN PWR ON 3DS3 indicator lamps light.

4-88. LINE VOLTAGE METERING CIRCUIT. The line voltage metering circuit consists of LINE VOLTS meter 3A3M3, LINE VOLTS switch 3A3S3, and fuses 3A3F1 through 3A3F4. LINE VOLTS switch 3A3S3 provides a selection of the ac input voltages to be monitored on LINE VOLTS meter 3A3M3.

4-89. When LINE VOLTS switch 3A3S3 is in the CONTROL position, 120 volts ac from SHUT DOWN circuit breaker 3A3CB1 is applied to the meter. The other side of the meter is connected through the switch to neutral. The four remaining positions operate in a similar manner.

4-90. When LINE VOLTS switch 3A3S3 is in the REG/UNREG position, the regulated or unregulated 120 volts, whichever is supplied to external equipment (see para. 4-101), is measured on LINE VOLTS meter 3A3M3. Phase A of the input power to the 10-kw power amplifier is measured in reference to phase C when the switch is in position AC. Phase B of the input power is measured in reference to phase C when the switch is in position BC. Phase A of the input power is measured in respect to phase B when the switch is in position AB. LINE VOLTS meter 3A3M3 should indicate 208 volts when the switch is in either position AC, BC, or AB. Fuses 3A3F1 through 3A3F4 protect the meter in each position except the CONTROL position.

4-91. ENERGIZING THE ALARM POWER SUPPLY.

4-92. The 120-volt ac power is applied to transformer 3A3A3T1 through ALARM POWER and SHUT DOWN circuit breakers, 3A3CB11 and 3A3CB1, respectively.

4-93. ENERGIZING THE LIQUID AND AIR COOLING SYSTEM.

4-94. AC power is applied to 5-minute time delay (drop out) relay 3A3K4 through SHUT DOWN circuit breaker 3A3CB1 (fig. 4-12).

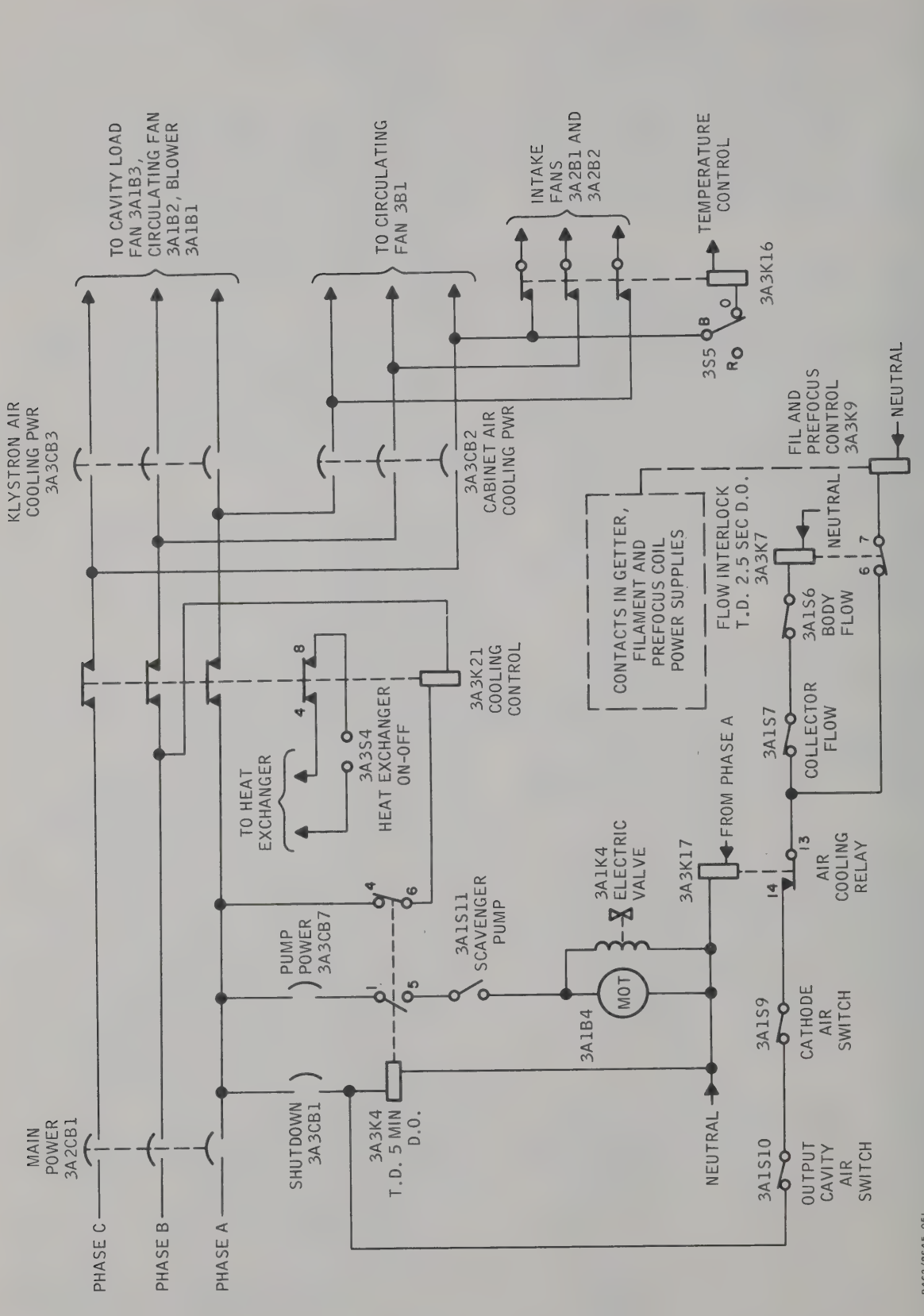

Figure 4-12. Energizing the Air and Liquid Cooling Circuits, Simplified Schematic Diagram

Relay 3A3K4 energizes opening contacts 1 and 5 ensuring that scavenger pump 3A1B4 will not be permitted to operate while the 10-kw power amplifier is in normal operation. Contacts 4 and 8 of relay 3A3K21 close completing the circuit to HEAT EXCHANGER switch 3A3S4. The external heat exchanger comes on at this time closing collector flow switch 3A1S7, and body flow switch 3A1S6 in the flow interlock (2.5-second time delay drop out) relay 3A3K7 circuit. Energizing cooling control relay 3A3K21 also applies 3-phase ac power through the contacts of relay 3A3K21, KLYSTRON AIR COOLING PWR circuit breaker 3A3CB3, and CABINET AIR COOLING PWR circuit breaker 3A3CB2 to the following fans and blower: cavity load fan 3A1B3, circulating fan 3A1B2, blower 3A1B1 and circulating fan 3B1.

4-95. Cathode air switch 3A1S9 and output cavity air switch 3A1S10 close when the fans and blower are on. AC power is applied to relay 3A3K7 through air switches 3A3S9 and 3A3S10, closed contacts 13 and 14 of energized air cooling relay 3A3K17, and flow switches 3A1S6 and 3A1S7. Relay 3A3K7 energizes, closing contacts 6 and 7 thus energizing filament and prefocus control relay 3A3K9.

4-96. When SHUT DOWN circuit breaker 3A3CB1 is operated to the OFF position, 5 minutes time delay drop out relay 3A3K4 contacts will not deenergize for 5 minutes. Cooling control relay 3AK21 will therefore remain energized for 5 minutes, thus keeping the heat exchanger and air cooling system operating. Interruptions to the ac input power for less than 2.5 seconds will not de-energize flow interlock 2.5-second time delay relay 3A3K7, thereby causing filament and prefocus control relay 3A3K9 to remain energized. This 2.5-second delayed dropout action ensures that the filament circuit, which is controlled by relay 3A3K9, will not be deenergized. Any ac power interruption greater than 2.5 seconds will cause relay 3A3K7 to deenergize, thereby deenergizing the filament circuits.

4-97. SCAVENGER PUMP.

4-98. Five minutes after ac power has been removed by the operation of SHUT DOWN circuit breaker 3A3CB1 to the OFF position, contacts 1 and 5 of relay 3A3K4 close. AC power (fig. 4-12) is applied through PUMP POWER circuit breaker 3A3CB7, contacts 1 and 5 of relay 3A3K4, and SCAVENGER PUMP switch 3A1S11 to pump motor 3A1B4. Electric valve 3A1K4 automatically turns off the scavenger pump motor when the liquid coolant is removed from the klystron carriage.

4-99. CABINET TEMPERATURE CONTROL CIRCUIT.

4-100. A change of ambient room temperature from 10°C (50°F) to 30°C (86°F) does not change the interior cabinet temperature by more than 5°C (9°F). The temperature control is achieved by the following air-cooling circuit. When the cabinet temperature approaches a 5°C (9°F) change, the plunger on the cabinet temperature thermal unit opens the louvers on the roof of the cabinet. If the interior cabinet temperature continues to rise, the louvers eventually open all the way and actuate thermal switch 3S5 (fig. 4-12), which completes the input circuit to temperature control relay 3A3K16. The relay energizes applying 3-phase ac power to intake fans A2B1 and A2B2. When the cabinet temperature drops due to the additional air flow, the plunger on the thermal unit travels the opposite way, opening microswitch 3S5. Temperature control relay 3A3K16 deenergizes and opens the input circuit to intake fans 3A2B1 and 3A2B2. As the plunger of the thermal unit continues to travel back, the louvers gradually close.

4-101. 120-VOLT REGULATOR POWER DISTRIBUTION CIRCUIT.

4-102. The 120-volt regulator power distribution circuit (fig. 4-13) distributes regulated voltage for the filament, prefocus coil, and getter power supply circuits, and also for external use, typically an exciter and two receivers. The 10-kw power amplifier receives single-phase, unregulated 120 volts ac at terminal board 3TB2. This causes SINGLE PHASE PWR ON indicator lamp 3DS2 to go on. When SHUT DOWN circuit breaker 3A3CB1 is OFF and relay 3K4 on the 10-kw power amplifier cabinet is deenergized, this voltage passes through buck-boost transformer 3T5, to the external equipment. SHUT DOWN circuit breaker 3A3CB1 energizes relay 3K4 and causes indicator lamp 3A3DS5 to go on.

4-103. With relay 3K4 energized, the unregulated 120 volts ac is applied through contacts 9 and 6 of relay 3K4, and auxiliary contacts of MAIN POWER circuit breaker 3A2CB1, to REGULATED POWER circuit breaker 3A3CB6 and to FIL PWR circuit breaker 3A3CB4. Circuit breaker 3A3CB6 activates the 120-volt regulator circuit. The unregulated 120 volts ac from REGULATED POWER circuit breaker 3A3CB6 energizes relay 3A3K6, which substi-

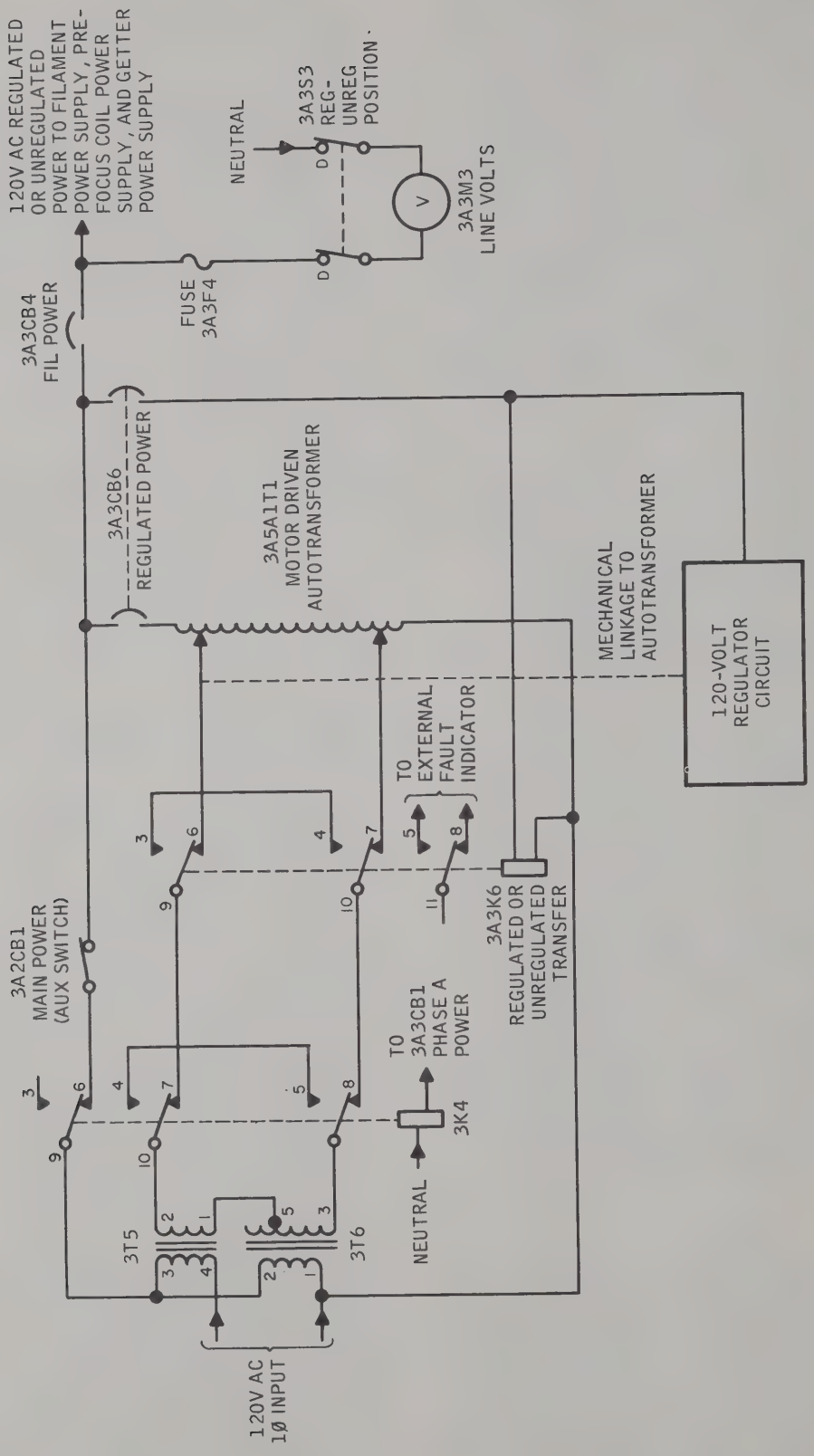

Figure 4-13. 120-Volt AC Regulated Power Distribution, Simplified Schematic Diagram

tutes regulated for unregulated power. If the regulated power fails internally during operation, relay 3A3K6 deenergizes transferring operation back to unregulated power and completes the circuit to an external fault indicator.

4-104. One section of REGULATED POWER circuit breaker 3A3CB6 applies input voltage to motor-driven variable autotransformer 3A5A1T1; the other section applies sensing voltage to 120-volt regulator circuit and energizes relay 3A3K6, lighting SINGLE PHASE REG ON indicator lamp 3DS7. FIL UNREG indicator lamp 3A3DS5 goes off.

4-105. The single-phase, 120-volt ac input, which is applied as a sensing voltage to 120-volt regulator circuit, varies ±5 percent regulation. Stepdown transformer 3T6 has been incorporated in the 120-volt regulator power distribution circuit to supply a constant boost voltage of 0 to 4 volts ac in 1-volt increments to compensate for the voltage drop due to line length. The equipment as supplied is connected for a fixed boost of 2 volts.

4-106. If the unregulated ac voltage is greater or less than 120 volts the 120-volt regulator circuit senses the difference and activates a motor which is mechanically linked to autotransformer 3A5A1T1. The output of autotransformer 3A5A1T1 is applied to transformers 3T5 and 3T6, through closed contacts 6 and 9, contacts 7 and 10 of reg-unreg transfer relay 3A3K6, and contacts 7 and 10 and 8 and 11 of relay 3K4. The voltage applied to transformers 3T5 and 3T6 from transformer 3A5A1T1 either adds to or subtracts from (depending on whether the ac input voltage fed to the 120-volt regulator control panel is high or low) the unregulated input ac voltage.

4-107. The regulated or unregulated 120 volts ac is fed through FIL PWR circuit breaker 3A3CB4 to the line volts meter circuit for monitoring purposes. The regulated or unregulated 120 volt ac voltage is also applied to the filament power supply, prefocus coil power supply, and the getter power supply.

4-108. ENERGIZING THE GETTER POWER SUPPLY, FILAMENT POWER SUPPLY AND PREFOCUS COIL POWER SUPPLY.

4-109. When filament and prefocus control relay 3A3K9 energizes (para 4-95) 120 volts is applied to the getter power supply, filament power supply, and the prefocus coil power supply through FIL PWR circuit breaker 3A3CB4.

4-110. ENERGIZING THE GETTER POWER SUPPLY. The 120 volt ac power is applied to transformer 3A1T2 through GETTER POWER circuit breaker 3A3CB5 contacts 13 and 14 of relay 3A3K9, and GETTER BOOST switch 3A352.

4-111. GETTER POWER indicator lamp 3A3DS18 goes off when GETTER POWER circuit breaker 3A3CB5 is in the ON position.

4-112. ENERGIZING THE PREFOCUS COIL POWER SUPPLY. PREFOCUS COIL PWR circuit breaker 3A3CB10 applies ac power to prefocus interlock relay 3A3K14 through closed contacts 10 and 11 of relay 3A3K9 and to the winding of variable autotransformer 3A1T1 through current limiting resistor 3A3R30. Interlock relay 3A3K14 closes contacts 10 and 11 in the beam control circuit.

4-113. Turning PREFOCUS COIL CURRENT ADJUST control 3A1T1 clockwise applies power through inductor 3A7L1 and resistor 3A7R7 to silicon rectifier bridge 3A7CR1. Inductor 3A7L1 serves as a ballast to keep prefocus coil current constant despite changes in the prefocus coil resistance. Resistor 3A7R7 is bypassed by contacts 9 and 10 of beam step control relay 3A3K12 during initial warmup. When the beam voltage is turned on contacts 9 and 10 of relay 3A3K12 open. One-half second later the parallel contacts of relay 3A5K2 close in beam step 2 operation, placing a second short across resistor 3A7R7. Resistor 3A7R7 absorbs the power surge during the half-second pause, thus preventing excessive prefocus coil current and consequent shut down due to high body current.

4-114. FILAMENT DISTRIBUTION CIRCUIT. FIL POWER circuit breaker 3A3CB9 (fig. 4-14) applies 120 volts ac from FIL PWR circuit breaker 3A3CB4 to KLYSTRON FIL VOLTS ADJUST autotransformer 3A3T1 through paralleled contacts 4 - 5 and 19 - 20 of relay 3A3K9, and filament stepping resistor 3A3R31. Autotransformer 3A3T1 determines the amplitude of the primary voltage to klystron filament power transformer 3T4. Filament cam switch 3A3S1 closes when autotransformer 3A3T1 is rotated through position 5. Closing the filament cam switch applies 120 volts ac to filament step (three second time delay pull in) relay 3A3K8. AC power is also applied to FILAMENT HOURS meter 3A3M1, FILAMENT CKT ON indicator lamp 3DS8 and beam control relay 3A3K15 and associated sequence control relays, circuit breakers, and switch contacts. Three seconds

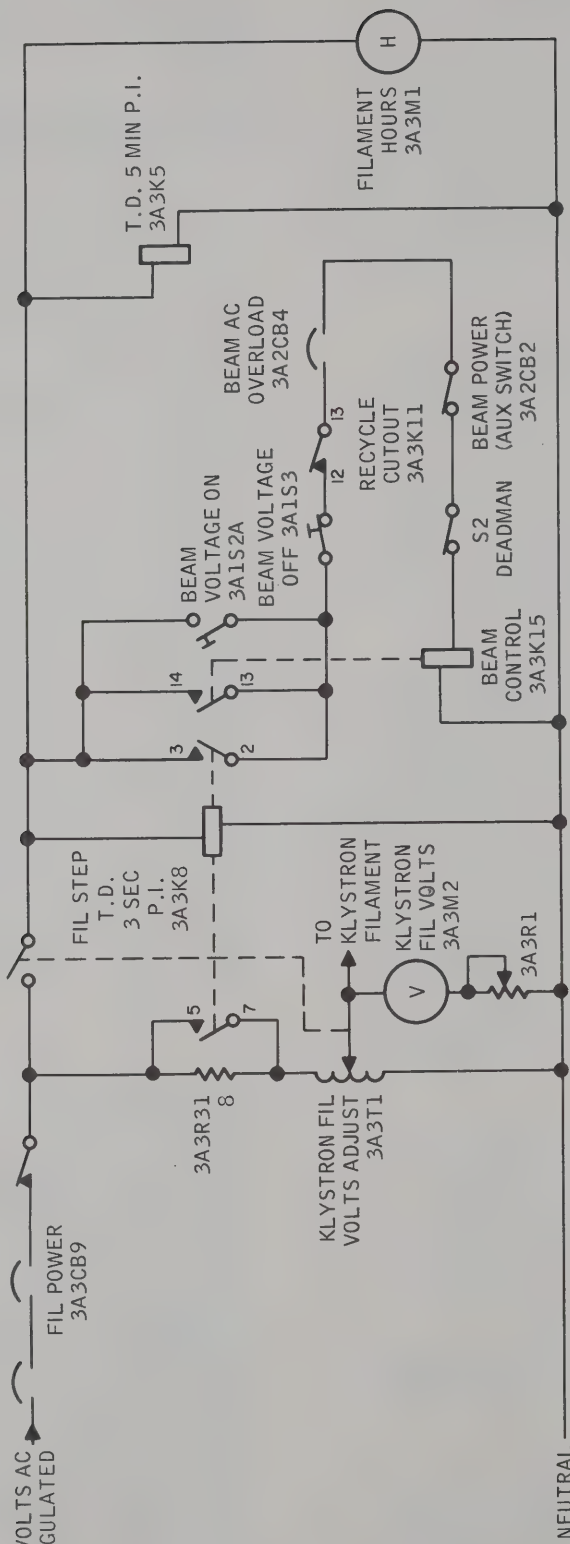

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Figure 4-14. Filament and Beam Control Distribution Sequence, Simplified Schematic Diagram

after filament cam switch 3A3S1 closes, relay 3A3K8 energizes, shorting resistor 3A3R31 applying full ac voltage to KLYSTRON FIL VOLTS ADJUST autotransformer 3A3T1.

4-115. FIELD COILS CONTROL CIRCUIT.

4-116. FIELD COILS POWER circuit breaker 3A3CB8 applies 3-phase ac power to the contacts of field coils relay 3A3K20 and to field coils interlock relay 3A3K13. Interlock relay 3A3K13 closes contacts 10 and 11 in the beam control circuit. Field coils relay 3A3K20 is energized by SHUT DOWN circuit breaker 3A3CB1, through all door and panel interlock switches. INTERLOCKS CHEATED red indicator lamps 3DS12 and 3DS13 go on when the interlock switches are by passed.

4-117. Energizing field coils relay 3A3K20 closes its three sets of contacts and applies 208-volt, 3-phase power to motor-driven variable autotransformer 3A6T1 through current limiting resistors 3A7R8, 3A7R9, and 3A7R10.

4-118. ENERGIZING THE BEAM POWER SUPPLY.

4-119. Five minutes after filament cam switch 3A3S1 is closed, the beam power supply will energize. AC power is applied to five minute time delay relay 3A3K5 (fig. 4-14), through filament cam switch 3A3S1. When relay 3A3K5 energizes, BEAM T. D. OVER indicator lamp 3DS10 lights. AC power energizes beam control relay 3A3K15 through manually depressed BEAM VOLTAGE ON switch 3A1S2A, BEAM VOLTAGE OFF switch 3A1S3, contacts 12 and 13 of recycle cutout relay 3A3K11, BEAM AC OVERLOAD circuit breaker 3A2CB4, BEAM POWER auxillary switch 3A2CB2, and deadman switch 3S2.

4-120. Beam step control relay 3A3K12 (fig. 4-15) is energized through contacts 10 and 11 of energized relay 3A3K15, section B of BEAM VOLTAGE ON switch 3A1S2, and contacts 2 and 6 of 5-minute time delay relay 3A3K5. Energizing relay 3A3K12 closes contacts 13 and 14 in the protective and alarm system, opens contacts 9 and 10 across prefocus coil current stepping resistor 3A7R7, and closes contacts 19 and 20, shorting out section B of BEAM VOLTAGE ON pushbutton 3A1S2. This ensures an operative circuit without keeping pushbutton 3A1S2 depressed. In addition, contacts 12 and 13 of recycle cutout relay 3A3K11 are shorted out by contacts 4 and 5 of relay 3A3K12.

4-121. Beam step 1 relay 3A5K1 is energized simultaneously with beam step control relay 3A3K12 through closed contacts 2 and 6 of 5-minute time delay relay 3A3K5 and contacts 3 and 5 of deenergized two-step time-delay relay 3A3K1.

4-122. Energizing beam step 1 relay 3A5K1 closes three sets of contacts, applying primary voltage to multitapped beam regulator autotransformers 3T2 and 3T3 through stepping resistors 3A5R1, 3A5R2, and 3A5R3. Stepping resistors 3A5R1 through 3A5R3 are incorporated to reduce the possibility of overloading during the application of primary power to beam power supply transformer 3T4.

4-123. In addition, contacts of relay 3A5K1, in series with two-step time-delay relay 3A3K1, close and apply ac power to the coil of relay 3A3K1. After a 0.5-second delay, contacts 9 and 11 of relay 3A3K1 close and energize beam step 2 relay 3A5K2.

4-124. Beam step 2 relay 3A5K2 closes its three sets of contacts in the beam voltage regulator circuit, shorting out the three contacts of beam step 1 relay and their series-connected stepping resistors 3A5R1 through 3A5R3. Another set of contacts of beam step 2 relay 3A5K2, in series with two-step time-delay relay 3A3K1 closes, paralleling the set of contacts of beam step 1 relay 3A5K1. Half a second later, the 1-second delay section of two-step time-delay relay 3A3K1 opens the input to beam step 1 contactor 3A5K1. This action releases its three contacts in the beam voltage regulator circuit and the set of contacts in series with relay 3A3K1, paralleled by relay 3A5K2 contacts.

4-125. When relay 3A5K1 deenergizes, ac power energizes ac power failure detector relay 3A3K10, which locks up through contacts 4 and 5. With beam step 2 relay energized, the beam voltage regulator circuit is set up to control the beam voltage applied to the klystron.

4-126. AUTOMATIC RECYCLING OPERATION.

4-127. Automatic recycling operation is normally utilized after the 10-kw power amplifier is warmed up and operating properly. RESET-NORMAL-AUTOMATIC switch 3A3S6 must be operated to the AUTOMATIC position. This action by-passes the manually operated BEAM VOLTAGE ON switch 3A1S2. The automatic recycling operation enables the equipment to immediately return to operation after a power

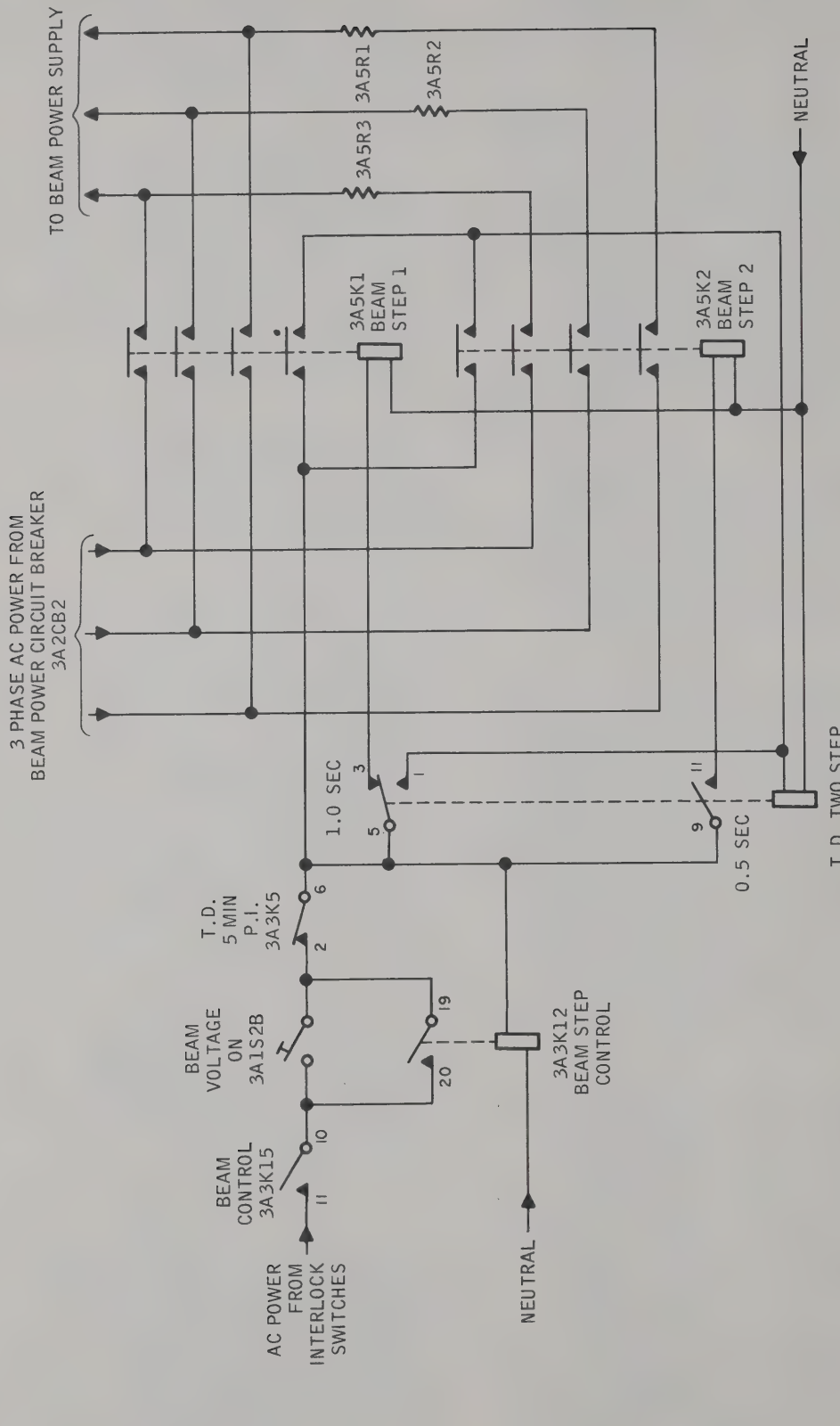

Figure 4-15. Energizing the Beam Power Supply, Simplified Schematic Diagram

failure of less than 2.5 seconds in duration. For power failures of greater than 2.5 seconds, the equipment will reenergize in 5 minutes plus the length of time of the power failure.

4-128. INTERRUPTIONS TO AC POWER FOR LESS THAN 2.5 SECONDS. If ac input power is interrupted by an ac power failure lasting less than 2.5 seconds, beam power is applied immediately after ac power is restored. The beam start circuit is energized through the normal string of interlock switches up to contacts 1 and 2 of RESET-NORMAL-AUTOMATIC switch 3A3S6 (fig. 4-16), the NORMAL contacts of TD CHEATER switch 3A3S5, and contacts 9 - 11 and 3 - 5 of two-step time-delay relay 3A3K2. The contacts of section A of the BEAM VOLTAGE ON pushbutton switch are shorted by contacts 2 and 3 of deenergized filament stepping relay 3A3K8.

4-129. Contacts 2 and 3 of relay 3A3K8 immediately close upon loss of ac power and remain closed until 3 seconds after ac power returns. Contacts 4 and 5 of relay 3A3K8 paralleled by contacts 19 and 20 of filament and prefocus control relay 3A3K9 (which is in series with FIL POWER circuit breaker 3A3CB9) are held closed by 2.5-second delayed dropout coolant flow interlock relay 3A3K7. Similarly, contacts 12 and 13 of recycle cutout relay 3A3K11 immediately close in series with BEAM VOLTAGE ON switch 3A1S2 and in parallel with contacts 4 and 5 of beam step control relay 3A3K12.

4-130. Deadman switch 3S2 opens with loss of power but recloses immediately with its return, completing the energizing path to beam control relay 3A3K15. In this manner the beam voltage is reapplied automatically.

4-131. INTERRUPTIONS TO AC POWER FOR MORE THAN 2.5 SECONDS. If the ac power is interrupted by an ac power failure lasting more than 2.5 seconds, the 10-kw power amplifier is energized automatically after the 5-minute time-delay elapses, at which time contacts 2 and 6 of time-delay relay 3A3K5 close.

4-132. INTERRUPTIONS IN DC AND INTERLOCK PATHS. If any dc failure or interlock interrupts the beam control circuit, beam power is applied immediately after the interruption has been corrected. In the dc circuits these occurrences are limited to one within a 5-minute period, unlike the short ac interruptions, any number of which can occur as long as their duration is 2.5 seconds or less.

4-133. There is no time limit for energizing the beam power supply in case of a dc overload or opening of an interlock. Contacts 2 and 6 of 5-minute time-delay relay 3A3K5 keep the ac circuit closed. The beam voltage is restored immediately when the overload condition is corrected or open interlocks closed.

4-134. Very high vswr and body current overload relays 3A1K2 and 3A1K3 respectively are automatically reset by the opening of contacts 13 and 14 of beam step control relay 3A3K12. All other overloads are reset manually. The resetting of relays is accomplished by momentarily moving RESET-NORMAL-AUTOMATIC switch 3A3S6 to RESET.

4-135. RECYCLE CUTOUT CIRCUIT.

4-136. When beam step 1 relay energizes, it opens a set of contacts in series with the ac power failure detector relay 3A3K10. At the same time another set of contacts close, energizing two-step time relay 3A3K1. After a time delay of half a second, relay 3A3K1 closes contacts 9 and 11 applying ac voltage to beam step 2 relay 3A5K2. A contact of relay 3A5K2 parallels the contact of beam step 1 relay 3A5K1 that holds relay 3A3K1 closed. Half a second later, relay 3A5K1 is deenergized by relay 3A3K1, transferring contacts 3 and 5 to contacts 1 and 5. Contacts 2 and 6 of relay 3A3K1, in series with ac power failure detector relay 3A3K10, close. Deenergizing relay 3A5K1 closes contacts in series with relay 3A3K10. Relay 3A3K10 is energized closing contacts 4 and 5 in series with its coil and contacts 10 and 11, in series with contacts 3 and 4 of RESET-NORMAL-AUTOMATIC switch 3A3S6, setting up the recycle cutout circuit for operation.

4-137. After a dc overload is corrected, the beam voltage again starts automatically. As the beam step 1 relay transfers, control voltage is applied to recycle cutout relay 3A3K11 and the recycle reset time delay relay 3A3K3, which starts 5-minute time delay. Recycle cutout relay 3A3K11 closes holding contacts 19 and 20 and opens contacts 12 and 13 across contacts 4 and 5 of beam step control relay 3A3K12 in the filament distribution circuit. Contacts 10 and 11 of relay 3A3K11 in the alarm power supply circuit close to prevent automatic resetting of VERY HIGH VSWR and BODY OVERLOAD indicator lamps.

4-138. If another overload occurs, deenergizing the beam control circuit drops out beam step control relay 3A3K12. Contacts 4 and 5

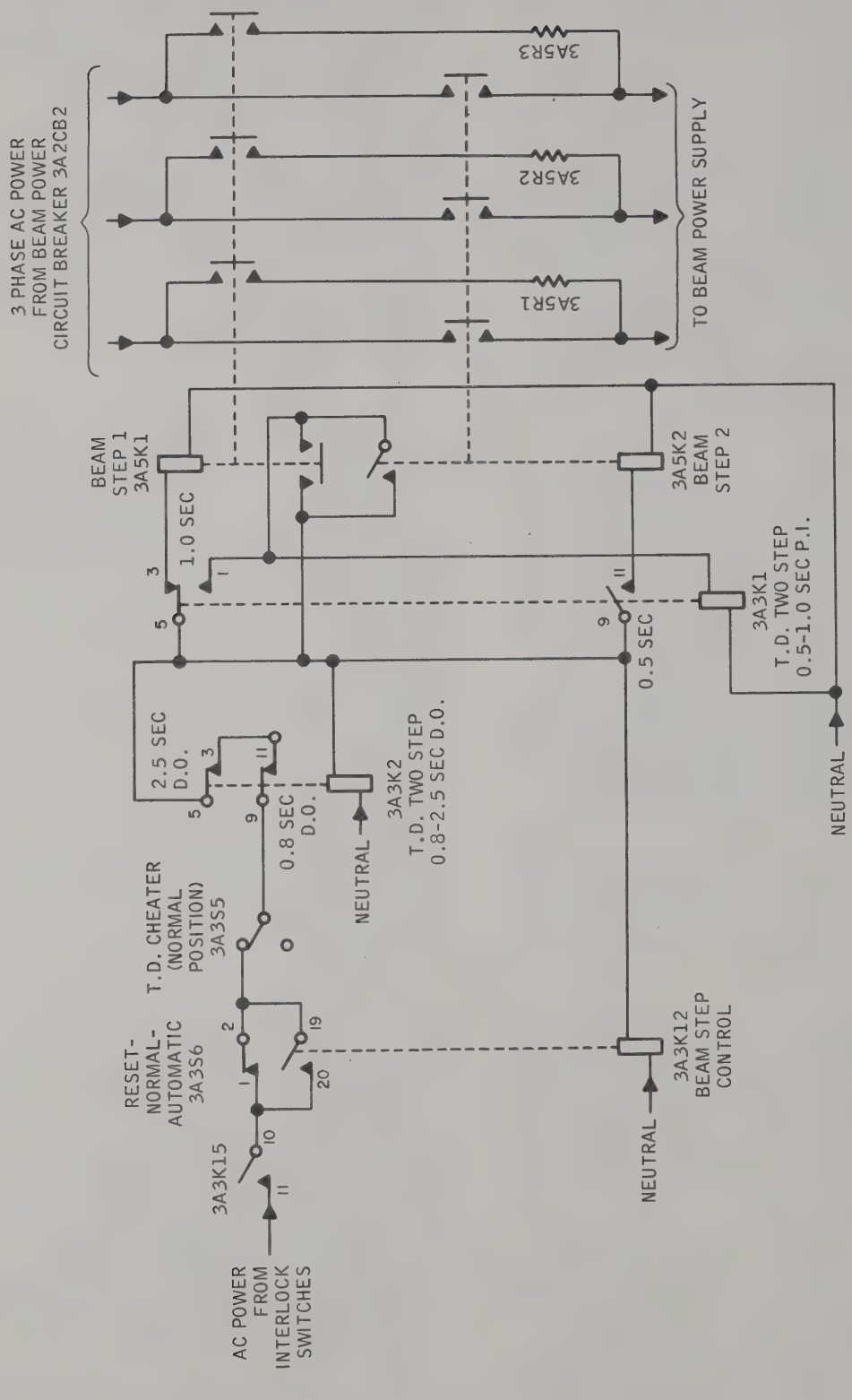

Figure 4-16. AC Power Distribution Sequence for AC Power Failure of Less Than 2.5 Seconds, Simplified Schematic Diagram

in the string of interlocks across the filament supply circuit open. Since closed contacts 12 and 13 of recycle cutout relay 3A3K11, normally across contacts 4 and 5 of relay 3A3K12, were opened when the previous dc overload occurred, beam control relay 3A3K15 is de-energized. Contacts 10 and 11 of relay 3A3K15 in the beam control circuit open, shutting off the beam voltage. The beam start circuit is kept disabled for 5 minutes because contacts 4 and 6 of recycle reset relay 3A3K3 are closed for that long.

4-139. After a time delay of 5 minutes, recycle reset relay 3A3K3 opens normally closed contacts 4 and 6 in series with recycle cutout relay 3A3K11. Holding contacts 19 and 20 of relay 3A3K11 open and contacts 12 and 13 in filament distribution circuit open, bridging contacts 4 and 5 of beam step control relay 3A3K12. Contacts 10 and 11 of relay 3A3K11 in the alarm power supply circuit open, allowing automatic resetting of the VERY HIGH VSWR and BODY OVERLOAD indicator lamps. Contacts 3, 4, and 5 of relay 3A3K11 are connected to an external fault indicator. With the recycle circuit reset, the unit starts automatically in case of another overload.

4-140. TIME DELAY CHEATER CIRCUIT.

4-141. The time delay cheater circuit is normally used when restarting the power amplifier after a short interruption of operation, thereby omitting the warmup period. In the event of an emergency, the power amplifier can be started cold, bypassing the normal 5-minute, warmup time delay with the help of the cheater circuit.

4-142. In order to activate the cheater circuit, TD CHEATER switch 3A3S5 is set to the CHEATER position. A special locking device holds the switch in this position. One set of contacts of switch 3A3S5 transfer, interrupting the beam control circuit and shorting contacts 2 and 6 of beam time delay relay 3A3K5. Another set of contacts of switch 3A3S5 close, and enable BEAM T.D. OVER indicator lamp 3DS10 to go on.

4-143. POWER SUPPLY SYSTEM.

4-144. PREFOCUS COIL POWER SUPPLY.

4-145. The prefocus coil power supply (fig. 4-17) provides the variable voltage required for the klystron prefocus coil. The power supply is capable of supplying 0-70 vdc with a maximum current capability of 1.05 amperes.

4-146. The ac input (120 vac) from the ac power distribution system is applied to rectifier bridge 3A7CR1 through terminals 1 and 2 of circuit breaker 3A3CB10, previously closed contacts 10 and 11 of relay 3A3K9, current limiting resistor 3A3R30, PREFOCUS COIL CURRENT ADJUST transformer 3A1T1, terminals 3 and 4 of circuit breaker 3A3CB10, coil 3A7L1, and resistor 3A7R7. The output of rectifier bridge 3A7CR1 is filtered by capacitor 3A7C1 in series with current limiting resistor 3A7R1, and is connected to prefocus coil 3A1L1 through PREFOCUS COIL CURRENT meter 3A4M5.

4-147. Coil 3A7L1 serves as a ballast to keep prefocus coil current constant in spite of changes in prefocus coil resistance.

4-148. Resistor 3A7R7 is normally shorted out by contacts 9 and 10 of relay 3A3K12 or contacts 7 and 8 of relay 3A5K2. Only during the first half second after application of klystron beam voltage is the short removed, decreasing the prefocus coil current, thereby preventing a surge in klystron body current.

4-149. PREFOCUS COIL PWR indicator lamp 3A3DS22 and its associated current limiting resistor 3A3R6 are provided to indicate application of ac power to the prefocus coil power supply. Capacitor 3A4C5 bypasses any stray rf signals around PREFOCUS COIL CURRENT meter 3A4M4.

4-150. FIELD COILS POWER SUPPLY. The field coils power supply (fig. 4-18) works in conjunction with the field coils regulator circuit in the ac regulator system to provide 105-308 vdc at a relatively constant current level to the field coils (including the collector coil).

4-151. The three-phase 208 vac from the ac power distribution system is connected to motor-driven variable autotransformer 3A6T1 through FIELD COILS POWER circuit breaker 3A3CB8; the contacts of relay 3A3K20; and current limiting resistors 3A7R8, 3A7R9 and 3A7R10. Relay 3A3K20 is activated only when all door and panel interlocks in the protective and alarm system are closed.

4-152. The output of transformer 3A6T1 is rectified by three-phase diode bridge 3A7CR2, filtered by capacitor 3A7C5 in series with resistor 3A7R5, and applied to the klystron field coils through FIELD COILS CURRENT meter 3A4M4 and resistor 3A7R6.

4-153. The current through resistor 3A7R6 developes a sensing voltage which is connected

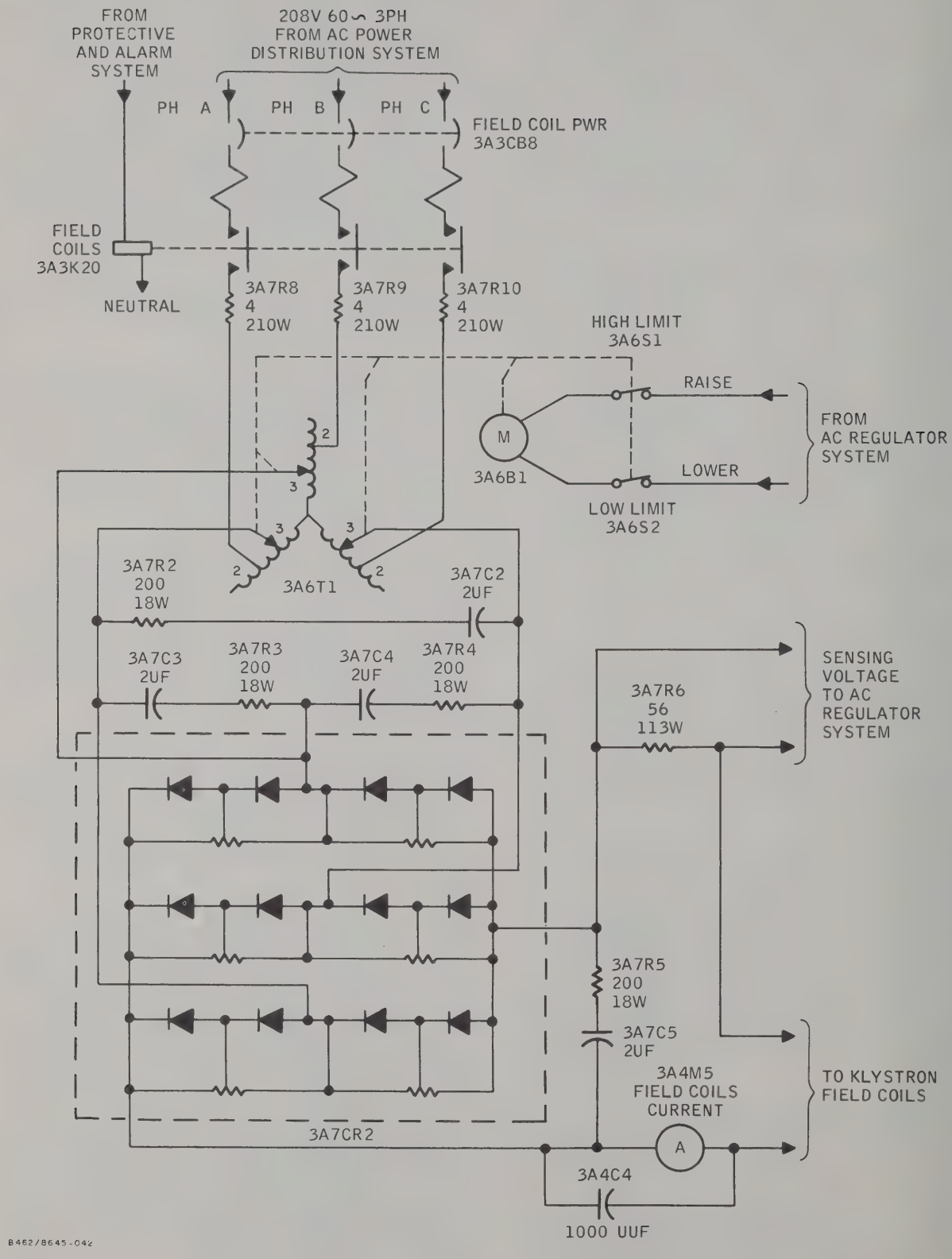

Figure 4-17. Prefocus Coil Power Supply, Simplified Schematic Diagram

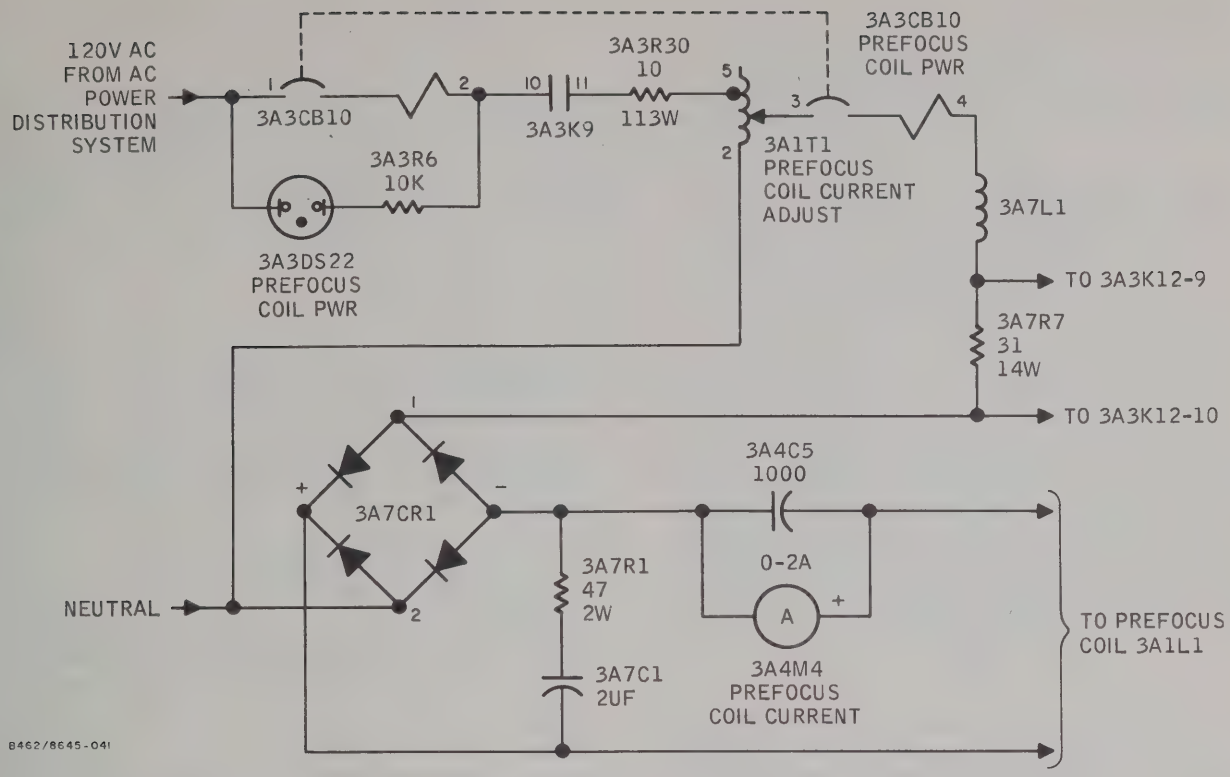

Figure 4-18. Field Coils Power Supply, Simplified Schematic Diagram

to the ac regulator system. The ac regulator system in turn provides a raise or lower signal to motor 3A6B1 through HIGH LIMIT switch 3A6S1 or LOW LIMIT switch 3A6S2. The resistor-capacitor combinations between each of the three phases (3A7R2-3A7C2, 3A7R3-3A7C3, 3A7R4-3A7C4) accomplish damping for any sudden changes in ac voltage due to a movement of autotransformer 3A6T1. Capacitor 3A4C4 connected in parallel with meter 3A4M4 bypasses stray rf signals.

4-154. GETTER POWER SUPPLY.

4-155. The input power to the getter power supply (fig. 4-19) is provided by the ac power distribution system to getter transformer 3A1T2 through GETTER POWER circuit breaker 3A3CB5, contacts 13 and 14 of relay 3A3K9, and GETTER BOOST switch 3A3S2. The secondary of transformer 3A1T2 is connected to the getter of the klystron tube. In normal operation, 2 volts at 30 amperes is applied to the klystron getter. With GETTER BOOST switch set for boast (up) the power is stepped up to 4 volts at 50 amperes. The klystron getter absorbs the small quantities of gas that are liberated from the hot electrodes during normal operation.

4-156. BEAM POWER SUPPLY.

4-157. The beam power supply furnishes the beam and bias voltages for the klystron tube (refer to sheet 1 of figure 6-3).

4-158. The beam power supply utilizes a highly efficient, delta-wye, step-up transformer connected in a conventional 3-phase, full-wave rectifier, bridge circuit.

4-159. The bridge output is filtered by the choke contained in beam power transformer 3T4 and capacitors 3C3 and 3C4.

4-160. To better understand the relationship of the beam power supply to the klystron tube an analogy can be made to a simple vacuum tube circuit. In this vacuum tube circuit, the plate is connected to the positive side of the power source, the grid is connected to the negative side of the power source, and the cathode is connected through resistance to the negative side of the power source. Therefore, the grid is negative with respect to the cathode, and the plate is positive in relation to the cathode. If the resistance between the negative side of the power source and the cathode is made variable, the negative relationship of the grid to the cathode (bias) can be adjusted.

4-161. The klystron collector (plate) is connected to the positive side of the power source (essentially ground) through the coil of beam

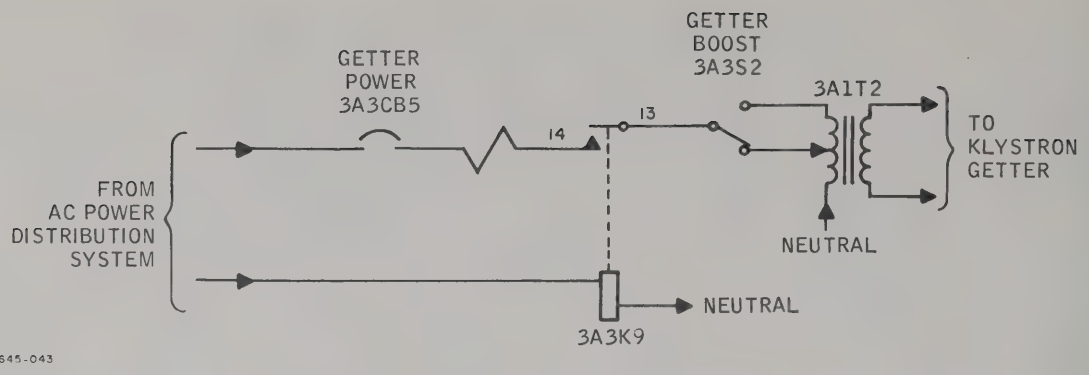

Figure 4-19. Getter Power Supply, Simplified Schematic Diagram

overload relay 3K1 and BEAM CURRENT meter 3A4M2. The focus anode (grid) is connected to the negative side of the power source (approx -17 kv) through current limiting resistors 3R6, 3R7 and 3R8. The cathode is connected to the negative side of power source through BIAS VOLTAGE ADJUST control 3A2R6, resistors 3A2R5, 3A2R4 and 3A2R3.

4-162. The bias voltage is measured by BIAS VOLTAGE meter 3A2M1. The voltage between the cathode and collector is measured by BEAM VOLTS meter 3A4M1 in series with meter multiplier resistors 3R2, 3R3, 3R4, and 3R5, and shunted by resistor 3A4R1. The total beam power supply current is measured by BEAM CURRENT meter 3A4M2 shunted by resistor 3A4R2. Capacitors 3A3C1, 3A4C1, and 3A4C2 bypass rf currents around their respective meters. Varistor 3A2RV1 protects meter 3A2M1, bypassing high fault currents.

4-163. Resistors 3R9 through 3R12 act as a bleeder resistance across the beam power supply. Capacitors 3C1 and 3C2 are provided to damp out meter fluctuations caused by transients. These capacitors were changed to 0.5 microfarad by REL modification 205 in order to increase the damping effect. Varistors 3RV1 and 3A4RV1 clamp their respective circuits to ground in the event that high voltage should appear across their associated components.

4-164. Spark gap 3E2 in series with current limiting resistor 3R1 protects the components of the beam power supply from excessive peak voltages. The filter choke is protected separately by spark gap 3E5 in series with current limiting resistor 3R15.

4-165. The deadman switch is mechanically connected to relay 3K3 in the ac power distribution system. When ac input power to the beam power supply is removed the deadman switch closes, discharging capacitor 3C3 and 3C4 to ground, thereby eliminating a safety hazard.

4-166. FILAMENT POWER SUPPLY.

4-167. The filament power supply provides an adjustable ac voltage (0-10 vac) for the filament of the klystron tube. Refer to sheet one of figure 6-3.

4-168. The regulated 120 vac is routed through the ac power distribution system to KLYSTRON FIL VOLTS ADJUST variable autotransformer 3A3T1. The variable autotransformer output is monitored by KLYSTRON FIL VOLTS meter 3A3M2 and applied to the filament transformer within the beam power transformer. The secondary of the filament transformer is connected to the klystron tube filament. KLYSTRON FIL VOLTS meter 3A3M2 is calibrated by variable resistor 3A3R1 to indicate the voltage applied to the klystron filament. To give a greater range of calibration variable resistor 3A3R1 was changed from 2500 to 5000 ohms by REL modification no. 7.

4-169. KLYSTRON FIL CURRENT meter 3A3M4 is inductively coupled to the secondary of the filament transformer. The coupling winding is designed so that the current through meter 3A3M4 is the same as the filament current.

4-170. Capacitors 3A3C2 and 3A3C4 bypass rf currents around their respective meters.

4-171. AC REGULATOR SYSTEM.

4-172. BEAM VOLTAGE REGULATOR CIRCUIT.

4-173. The beam voltage regulator circuit

controls the regulated 208-vac, three-phase power to the beam power supply.

4-174. The beam voltage regulator circuit consists primarily of bridge power supply, a balanced bridge circuit, variable autotransformers, a control meter, and raise-lower relays with associated bridge rectifiers. (Refer to figures 6-10 and 6-12.

4-175. The ac input (sample voltage) for the bridge power supply is connected through the closed contacts (3 and 4) of POWER circuit breaker 3A3A4CB1, and current limiting resistor 3A3A4R1 paralleled by temperature compensating thermistor RT1. The sample voltage is full wave rectified by the diode bridge consisting of diodes 3A3A4CR1, 3A3A4CR2, 3A3A4CR3, and 3A3A4CR4; filtered by the pi-filter consisting of capacitors 3A3A4C1 and 3A3A4C2, and inductor 3A3A4L1.

4-176. The output of the bridge power supply is connected across the balanced bridge (see fig. 4-20) consisting of resistor 3A3A4R8, reference (zener) diode 3A3A4CR7, resistor 3A3A4R3, variable resistor 3A1R13A, variable resistor 3A3A4R4, variable resistor 3A1R13B and resistor 3A3A4R6. The adjustable tap on variable resistor 3A3A4R4 separates two bridge legs. The bridge balance is controlled by reference diode 3A3A4CR7.

4-177. When the sample voltage changes, the rectified input to the balanced bridge changes, upsetting the balance. This unbalance causes current to flow in the center arm of the bridge, thus energizing relay 3A3A4K1. SENSITIVITY control 3A3A4R5 (in series with current limiting resistor 3A3A4R7) is used to vary the degree of unbalance required to operate relay 3A3A4K1. CALIBRATE control 3A3A4R4 is used to adjust for aging and replacement differences in the characteristics of reference diode 3A3A4CR7. BEAM VOLTAGE ADJUST control 3A1R13 changes the balance and thereby adjusts the level at which the circuit will regulate. Varistor 3A3A4RV1 is a surge protector, bypassing high current around the sensitive coil of relay 3A3A4K1.

4-178. Refer again to beam regulator control panel 3A3A4 schematic diagram. Relay 3A3A4K1 is a polar type relay; in response to a decrease in sample voltage will energize raise relay 3A3A4K2 through contacts 1 and 4,

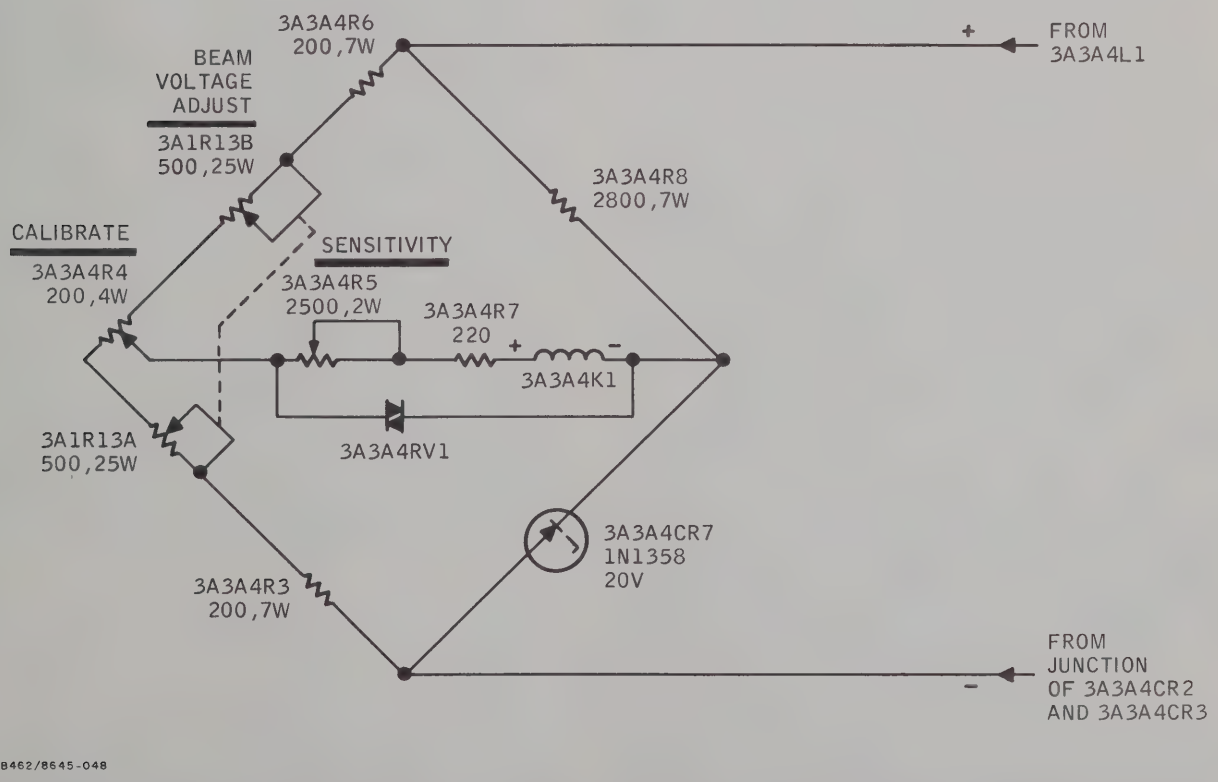

Figure 4-20. Beam Voltage Regulator Circuit Balanced Bridge, Simplified Schematic Diagram

in response to an increase in ac input voltage will energize lower relay 3A3A4K3 through contacts 1 and 7. The voltage to energize these relays is supplied through POWER circuit breaker 3A3A4CB1 and rectified by a separate diode bridge associated with each of the two relays. If circuit breaker 3A3CB1 opens LOW FWD POWER indicator lamp 3A4DS1 will come on.

4-179. When a decrease in sample voltage unbalances the bridge circuit contacts 4 and 5 of relay 3A3A4K2 close and a raise signal voltage is applied to beam control motor 3A5B1 through limit switch 3A5S1. Limit switch 3A5S1 opens the input to the motor when the minimum limit is reached. (Refer to beam power primary control 3A5 schematic diagram.) Beam control motor 3A5B1 rotates variable autotransformers 3A5T2 and 3A5T3 providing a higher output voltage. The control arms of switch 3A5S3 are mechanically linked to 3A5T2 and 3A5T3. At the end of each half turn of these transformers, switch 3A5S3 switches to the next higher autotransformer tap. A sample of this output voltage is applied from positioner transformer 3A5T1 to the input of the beam voltage regulator. Beam control motor 3A5B1 continues to rotate until the sample voltage restores the bridge balance, thereby deactivating relay 3A3A4K1. When relay 3A3A4K1 deactivates, contacts 4 and 5 of relay 3A3A4K2 open, thereby removing power from beam control motor 3A5B1.

4-180. When an increase in sample voltage unbalances the bridge circuit, contacts 4 and 5 of relay 3A3A4K3 close and a lower signal voltage is applied to beam control motor through limit switch 3A5S2. Limit switch 3A5S2 opens the input to the motor when the maximum limit is reached. Beam control motor rotates variable autotransformers 3A3T2 and 3A5T3 providing a lower output voltage. Mechanically linked switch 3A5S3 is also rotated, switching to the next lower tap for each half turn of 3A5T2 and 3A5T3. A sample of the output voltage is applied from positioner transformer 3A5T1 to the input of the beam voltage regulator. Beam control motor continues to rotate until the sample voltage restores the bridge balance, thereby deactivating relay 3A3A4K1. When relay 3A3A4K1 deactivates, contacts 4 and 5 of relay 3A3A4K3 open, thereby removing power from beam control motor 3A5B1.

4-181. When either raise relay 3A3A4K2 or lower relay 3A3A4K3 are activated, contacts 1 and 8 of either relay close shorting out SENSITIVITY control 3A3A4R5 so that the circuit operates at maximum sensitivity. When the voltage is at its correct value the raise or lower relay is deactivated and its contacts 1 and 8 will open.

4-182. BEAM VOLTAGE RAISE-LOWER switch 3A1S4 in the RAISE position parallels contacts 4 and 5 of raise relay 3A3A4K2 providing manual beam power adjustment in the raise direction. Switch 3A1S4 in the LOWER position parallels contacts 4 and 5 of lower relay 3A3A4K3 providing manual beam power adjustment in the lower direction.

4-183. 120-VOLT REGULATOR CIRCUIT.

4-184. The 120-volt regulator circuit provides regulated ac voltage to the filament, prefocus coil and getter power supplies. It also is capable of supplying 120 volts regulated ac to external equipment, typically an exciter and two receivers.

4-185. Refer to figures 6-7 and 6-12.

4-186. The principles of operation of the 120-volt regulator circuit are the same as the beam voltage regulator circuit, with the following exceptions: the beam voltage regulator has an autotransformer tap selecting switch (3A5S3) rotated by the control motor, the 120-volt regulator circuit does not; the beam regulator circuit has manual control capability (BEAM VOLTAGE ADJUST control 3A3A4R4 and BEAM VOLTAGE RAISE-LOWER switch 3A1S4) whereas the 120-volt regulator circuit does not.

4-187. FIELD COILS REGULATOR CIRCUIT.

4-188. The field coils regulator circuit keeps the current through the field coils at a relatively constant level. The circuit operates in a manner similar to that of the 120-volt regulator circuit. The primary difference is in the balanced bridge portion of the circuit.

4-189. Refer to figure 6-8.

4-190. Resistor 3A7R6 (part of field coils power supply) is one leg of a balanced bridge (see fig. 4-21). It is connected in series with

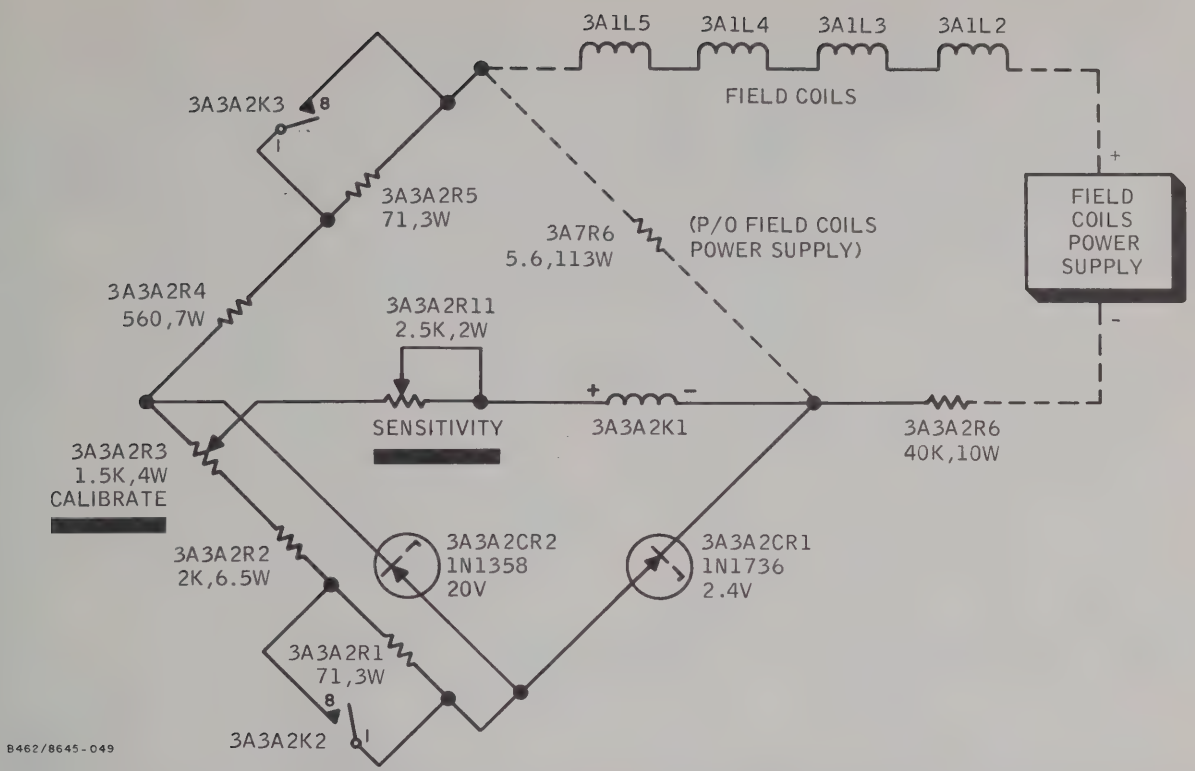

Figure 4-21. Field Coils Regulator Circuit Balanced Bridge, Simplified Schematic Diagram

the field coils, the field coil power supply, and current limiting resistor 3A3A2R6. Resistor 3A3A2R6 was increased from 33K to 40K ohms by REL modification 108. The remaining legs of the bridge consist of: reference (zener) diode 3A3A2CR1; resistor 3A3A2R1, resistor 3A3A2R2, variable resistor 3A3A2R3, paralled by reference (zener) diode 3A3A2CR2; resistor 3A3A2R4, and resistor 3A3A2R5.

4-191. When the current through the field coils changes, the voltage drop across resistor 3A7R6 changes proportionately, thereby upsetting the balance. This unbalance causes current to flow in the center arm of the bridge, thus energizing relay 3A3A2K1. SENSITIVITY control 3A3A2R11 is used to vary the degree of unbalance required to energize relay 3A3A2K1. CALIBRATE control 3A3A2R3 is used to adjust for aging and replacement differences in the characteristics of the reference diodes.

4-192. This circuit also differs from the 120-volt regulator circuit in that during the regulating action either resistor 3A3A2R1 or 3A3A2R5 (fig. 4-21), instead of the SENSITIVITY control 3A3A2R11 is shorted out by contacts 1 and 8 of relay 3A3A2K2 or 3A3A2K3 respectively. The effect is similar; however, in this circuit, the regulation action is primarily to maintain constant current flow through the field coils.

4-193. The principles of operation of the remainder of the field coils regulator circuit is the same as the 120-volt regulator circuit.

4-194. PROTECTIVE AND ALARM SYSTEM.

4-195. RF PROTECTIVE CIRCUIT.

4-196. LOW FORWARD POWER. A sample of the output power of the 10-kw power amplifier is obtained from rf output directional coupler 3A1DC5, rectified by diode 3A1CR7, filtered by capacitors 3A1C10 and 3A1C3, and measured by OUTPUT FORWARD meter 3A1M3. OUTPUT FORWARD CAL control 3A1R4 is provided to calibrate the meter to indicate the value of output power proportional to the sample.

4-197. In the event of low rf output forward power, OUTPUT FORWARD meter-relay 3A1M3 (fig. 4-22) completes the input to low forward power alarm relay 3A3A3K3. Energizing relay 3A3A3K3 closes contacts 4 and 5 in series with LOW FWD POWER indicator lamp 3A4DS1. Contacts 18, 19, and 20 of relay 3A3A3K3 are connected to an external fault indicator.

4-198. HIGH VSWR. A sample of the rectified output (back) power of the 10-kw power amplifier is obtained from rf output directional coupler 3A1DC5, rectified by diode 3A1CR4,

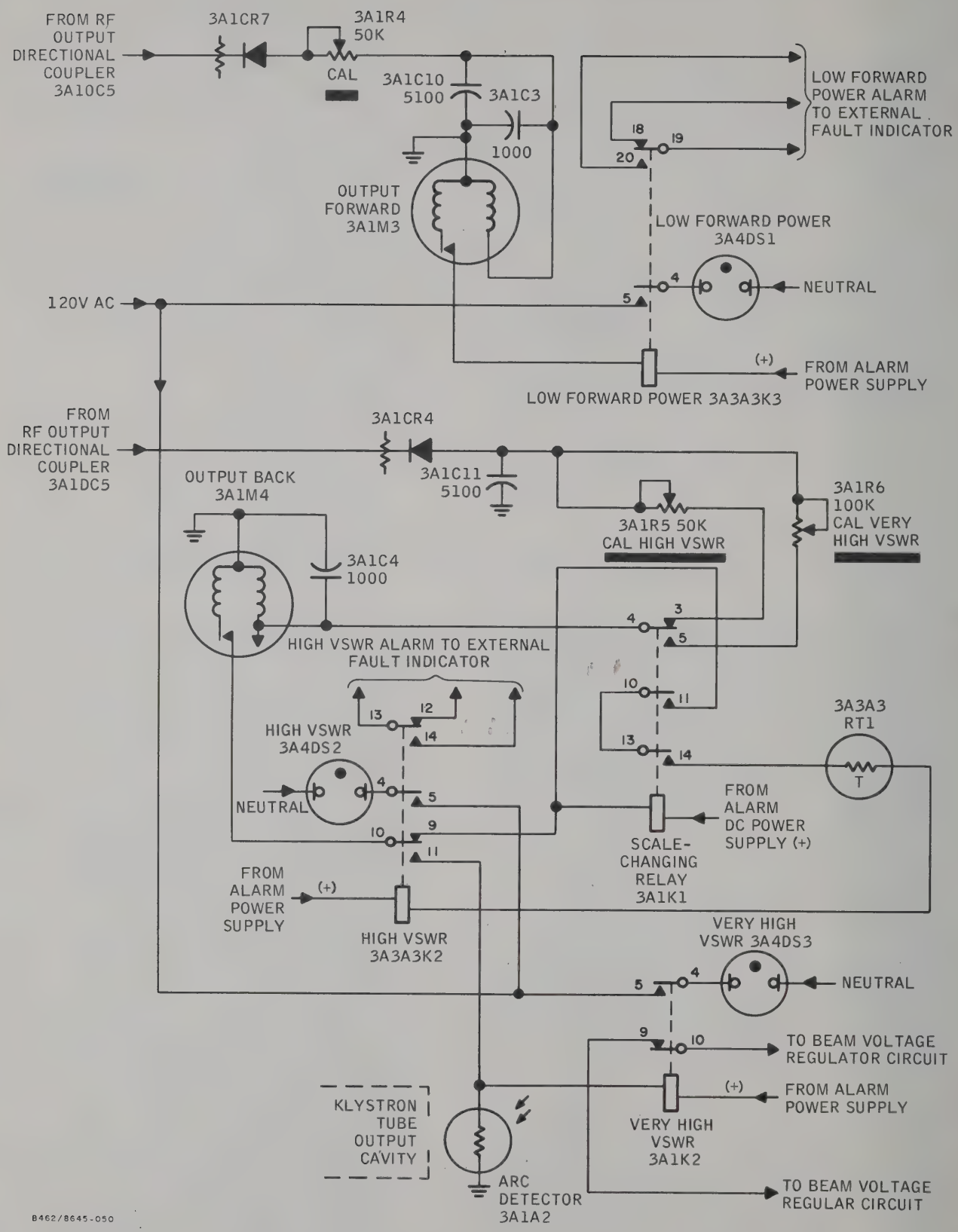

Figure 4-22. RF Protective Circuit, Simplified Schematic Diagram

filtered by capacitors 3A1C11 and 3A1C4, and measured by OUTPUT BACK meter 3A1M4 through CAL HIGH VSWR control 3A1R5 and normally closed contacts 3 and 4 of relay 3A1K1. CAL HIGH VSWR control 3A1R5 is provided to calibrate the meter to indicate the value of reflected power proportional to the sample.

4-199. In the event of high rf output back power, OUTPUT BACK meter-relay 3A1M4 (fig. 4-22) completes the input to scale-changing relay 3A1K1 through the normally closed contacts of relay 3A3A3K2. Relay 3A1K1 closes holding contacts 10 and 11 and 13 and 14 in series with thermistor 3A3A3RT1 and high vswr relay 3A3A3K2. Relay 3A1K1 closes contacts 4 and 5 inserting the higher resistance of CAL VERY HIGH VSWR control 3A1R6 in series with OUTPUT BACK meter-relay 3A1M4; resetting the meter to an extended range. CAL VERY HIGH VSWR control 3A1R6 is adjusted so that OUTPUT BACK meter 3A1M4 now indicates one-half of the reflected power. Closing contacts 13 and 14 of relay 3A1K1 applies voltage through thermistor 3A3A3RT1 to the coil of high vswr relay 3A3A3K2. The thermistor is incorporated to delay the action of relay 3A3A3K2. Energizing relay 3A3A3K2 transfers contacts 9 and 10 to contacts 10 and 11, setting up the very high vswr relay for operation. Contacts 4 and 5 of relay 3A3A3K2 close and HIGH VSWR indicator lamp 3A4DS2 goes on. Contacts 12, 13, and 14 of relay 3A3A3K2 are connected to an external fault indicator.

4-200. VERY HIGH VSWR. Very high vswr relay 3A1K2 (fig. 4-22) is energized by OUTPUT BACK meter-relay 3A1M4, through contacts 10 and 11 of relay 3A3A3K2, when it reaches the set limit for the very high vswr condition. Relay 3A1K2 closes contacts 4 and 5 VERY HIGH VSWR indicator lamp 3A4DS3 goes on. At the same time contacts 9 and 10 of relay 3A1K2 open and interrupt the beam voltage regulator circuit, shutting off the beam voltage. Relay 3A1K2 can also be activated by arc detector 3A1A2 located near the klystron tube output cavity. When the arc detector (photoelectric cell) senses an arc in the output cavity (caused by excessive vswr) its resistance to ground decreases, activating relay 3A1K2. Arc detector 3A1A2 was added by REL modification no. 202 as an added precaution.

4-201. BODY CURRENT PROTECTIVE CIRCUIT.

4-202. BODY CURRENT meter-relay 3A4M3 (fig. 4-23) indicates klystron tube body current. When the indication exceeds the preset current limit (up to 150 ma), meter-relay 3A4M3 operates and applies ground to body current relay 3A1K3. When energized, body current relay 3A1K3 opens contacts 9 and 10 in the ac power

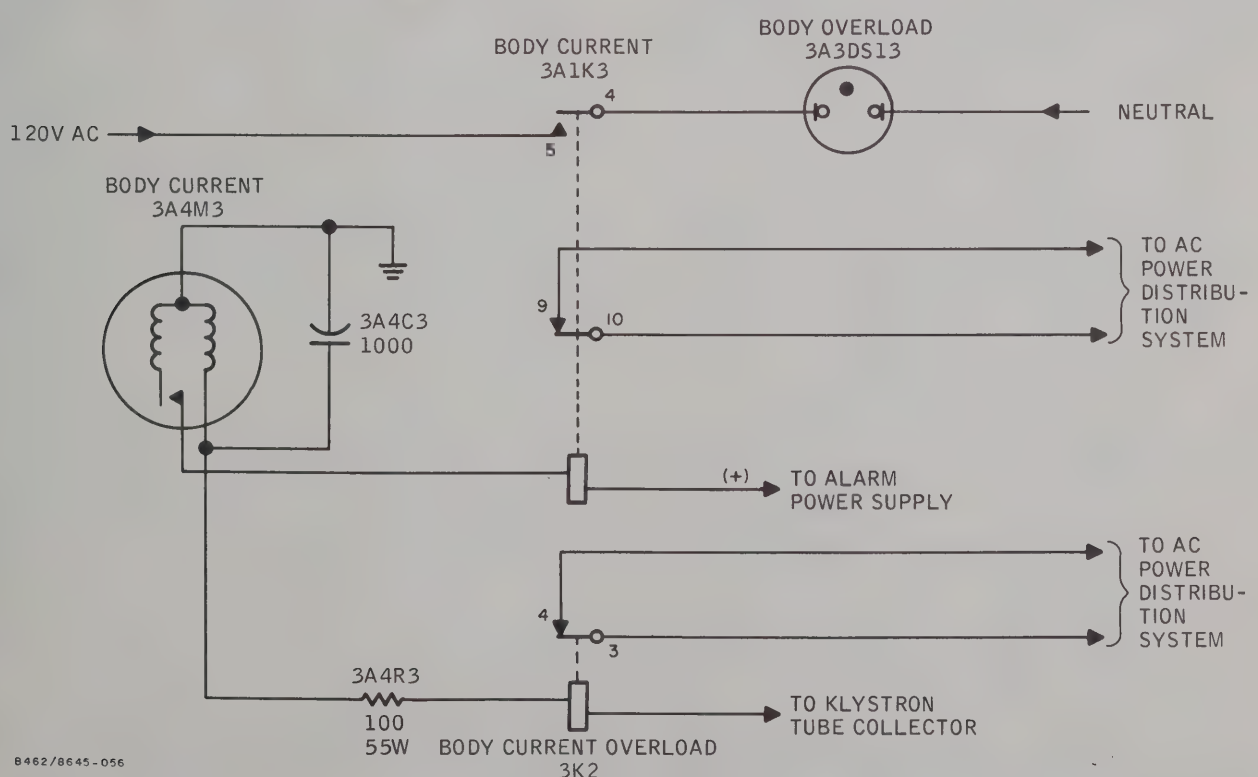

Figure 4-23. Body Current Protective Circuit, Simplified Schematic Diagram

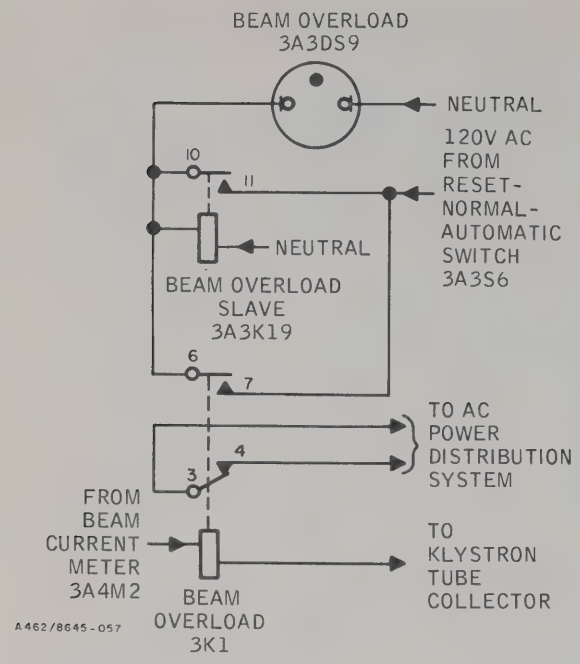

Figure 4-24. Beam Current Protective Circuit, Simplified Schematic Diagram

distribution system, removing beam voltage. Contacts 4 and 5 close, applying 120 vac to BODY OVERLOAD indicator lamp 3A3DS13.

4-203. Klystron tube body electrons return to the klystron tube collector (positive side of the beam power supply) from ground, through the coil of body current overload relay 3K2, series current limiting resistor 3A4R3 and meter-relay 3A4M3. The body current overload relay 3K2 energizes at 150 ma. If the body current exceeds 150 ma, regardless of setting of BODY CURRENT meter-relay 3A4M3, contacts 3 and 4 open in the ac power distribution system, removing beam voltage. Capacitor 3A4C3 bypasses transients around meter-relay 3A4M3.

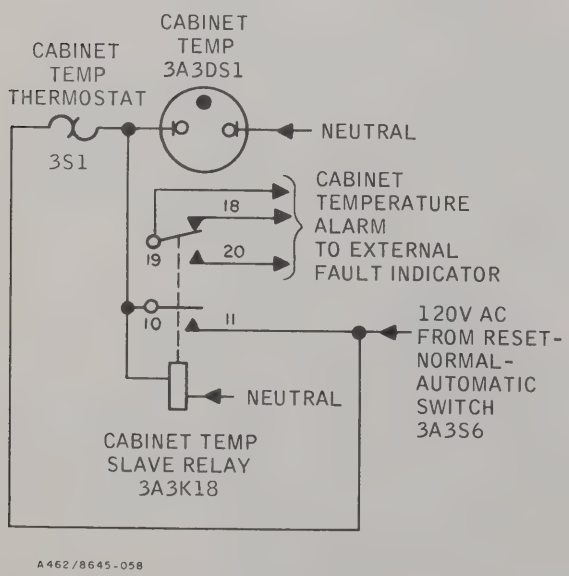

Figure 4-25. Cabinet Temperatur Alarm Circuit, Simplified Schematic Diagram

4-204. BEAM CURRENT PROTECTIVE CIRCUIT.

4-205. In the event of high beam current, exceeding the fixed limit of 2 amperes, beam current overload relay 3K1 (fig. 4-24) in the positive side of the beam power supply (in series with BEAM CURRENT meter 3A4M2 and the klystron tube collector) energizes. Contacts 6 and 7 of relay 3K1 close and BEAM OVERLOAD indicator lamp 3A3DS9 goes on. Closing contacts 6 and 7 of relay 3K1 also completes the circuit to beam overload slave relay 3A3K19. Relay 3A3K19 closes holding contacts 10 and 11, paralleling contacts 6 and 7 of relay 3K1, to keep the BEAM OVERLOAD indicator lamp on after beam current overload relay K1 becomes deenergized. After a beam overload, slave relay 3A3K19 requires resetting by moving RESET-NORMAL-AUTOMATIC switch 3A3S6 to RESET, thus momentarily opening the 120 vac to the coil of relay 3A3K19. Energizing overload relay 3K1 also opens contacts 3 and 4 in the ac power distribution system, removing beam voltage.

4-206. CABINET TEMPERATURE ALARM CIRCUIT.

4-207. In the event of excessive cabinet temperature 70°C or more (158°F or more), cabinet temperature thermostat 3S1 (fig. 4-25) closes its contacts, and CABINET TEMP indicator lamp 3A3DS1 goes on. Closing the contacts of thermostat 3S1 also completes the circuit to cabinet temperature slave relay 3A3K18. Relay 3A3K18 closes holding contacts 10 and 11, and also transfers contacts 18 and 19 to contacts 19 and 20, connected to an external fault indicator. After a cabinet temperature overload, slave relay 3A3K18 is reset by moving switch 3A3S6 to RESET, thus momentarily opening the 120 vac to the coil of relay 3A3K18.

4-208. COOLANT TEMPERATURE ALARM CIRCUIT.

4-209. In the event of excessive coolant temperature 70°C (158°F) or more, section B of COOLANT TEMP OVERLOAD RESET switch 3A1S8 (fig. 4-26) is closed by the action of the

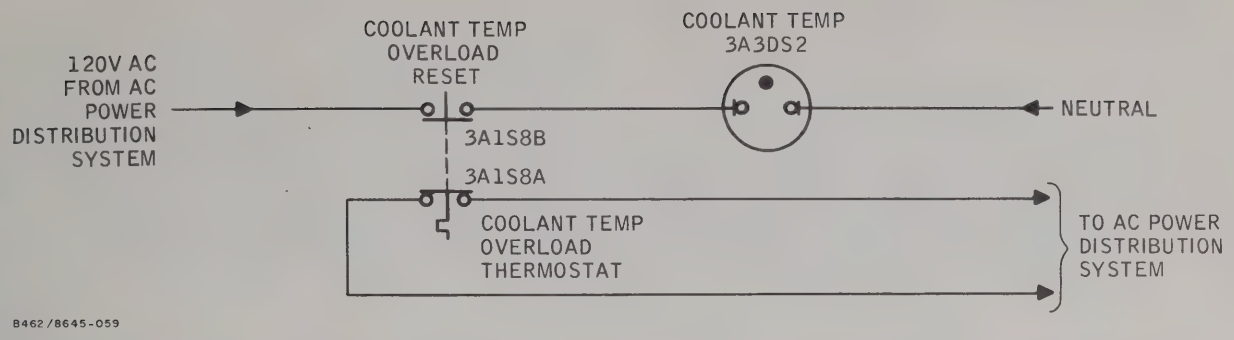

Figure 4-26. Coolant Temperature Alarm Circuit, Simplified Schematic Diagram

coolant temperature overload thermostat and COOLANT TEMP indicator lamp 3A3DS2 goes on. Section A of switch 3A1S8 is opened by the action of the coolant temperature overload thermostat and the beam interlock circuit in the ac power distribution system. COOLANT TEMP indicator lamp 3A3DS2 is turned off and the beam interlock circuit in the ac power distribution system is closed by pressing the COOLANT TEMP OVERLOAD RESET pushbutton. Section A of switch 3A1S8 operates 3°C (5°F) higher than section B.

4-210. PANEL OUT ALARM CIRCUIT.

4-211. PANEL OUT indicator lamp 3A3DS3 (fig. 4-27) indicates whether the four subassemblies of ac control panel 3A3 are properly installed and hooked up. If the plugs to any of the four subassemblies are not connected, PANEL OUT indicator lamp 3A3DS3 goes on, signifying that a panel is disconnected. The plugs and subassemblies involved are: plug 3A3P3 which plugs into 120-volt regulator control panel 3A3A1, plug 3A3P5 which plugs into field coils regulator control panel 3A3A2, plug 3A3P4 which plugs into alarm power supply 3A3A3, and plug 3A3P6 which plugs into beam regulator control panel 3A3A4. When all these plugs are connected, resistor 3A3R2 is connected across the 120-volt input from the ac power distribution system; when a plug is removed, the short circuit across indicator lamp 3A3DS3 is opened and the indicator lamp goes on, indicating that a panel is disconnected.

4-212. ALARM POWER SUPPLY.

4-213. Throwing ALARM POWER circuit breaker 3A3CB11 to ON applies single-phase, 120-volts ac to power supply transformer 3A3A3T1 (fig. 4-28). The secondary voltage of transformer 3A3A3T1 is rectified by silicon bridge rectifiers 3A3A3CR1 through 3A3A3CR4. The dc output voltage produced is applied to the various circuits in the protective and alarm system. Capacitor 3A3A3C1 is a transient bypass, shunted across the primary of transformer 3A3A3T1. Current limiting resistor 3A3A3R1 is connected in series with the rectifier bridge circuit. Filtering of the dc output is provided by capacitor 3A3A3C2 in parallel

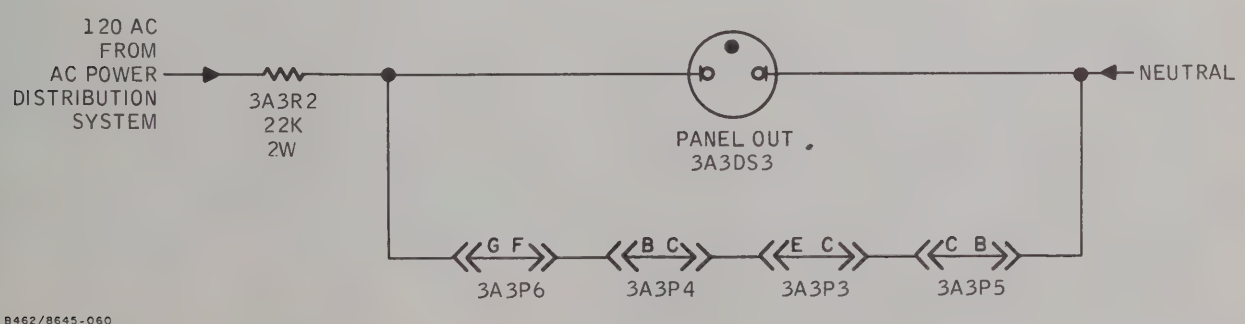

Figure 4-27. Panel Out Alarm Circuit, Simplified Schematic Diagram

with bleeder resistor 3A3A3R2 across the power supply output.

4-214. ALARM POWER SUPPLY FAILURE.

4-215. Alarm power supply failure relay 3A3A3K1 (fig. 4-28) is connected across the dc output of the alarm power supply rectifier bridge. Energizing relay 3A3A3K1 opens contacts 12 and 13 in series with ALARM PS FAILURE indicator lamp 3A3DS4. In the event of dc output failure, relay 3A3A3K1 deenergizes and closes contacts 12 and 13 in series with ALARM PS FAILURE indicator lamp 3A3DS4, causing the indicator lamp to go on. Contacts 3, 4, and 5 of relay 3A3A3K1 are connected to an external fault indicator.

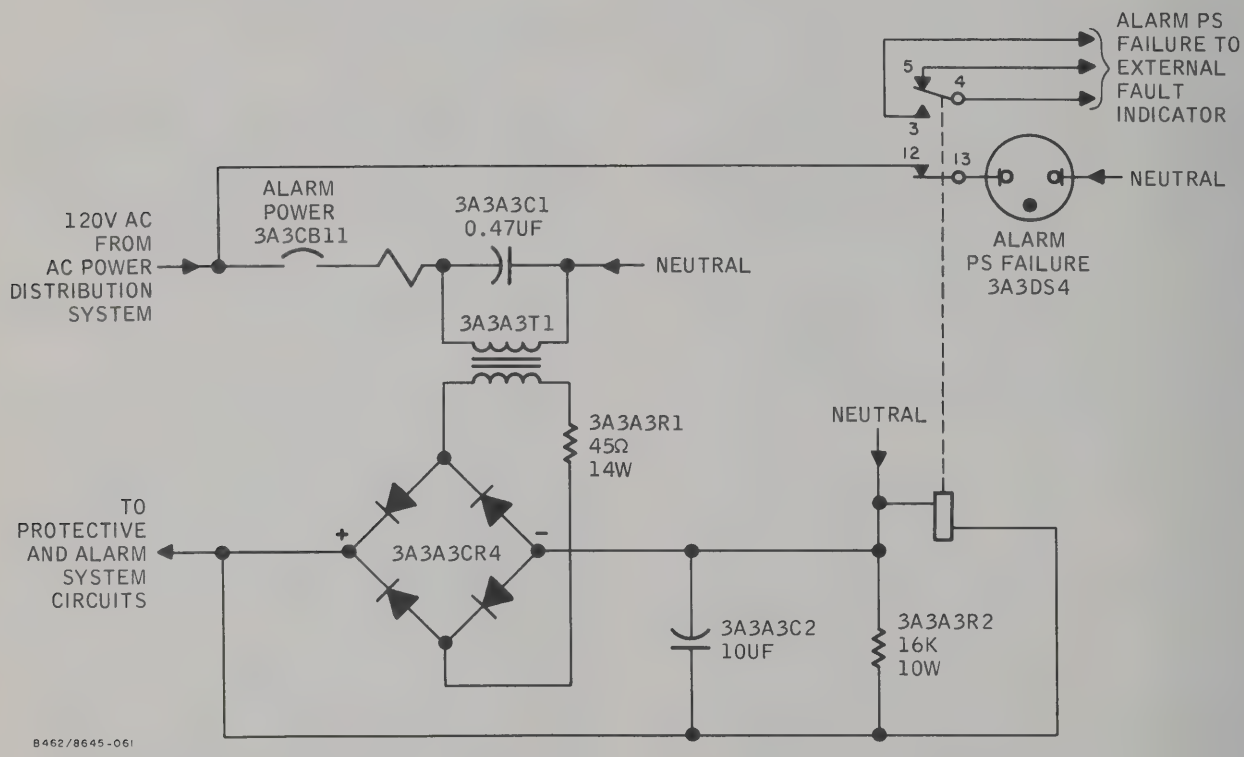

Figure 4-28. Alarm Power Supply Circuit, Simplified Schematic Diagram

SECTION II
FUNCTIONAL OPERATION OF MECHANICAL ASSEMBLIES

4-216. LIQUID COOLING SYSTEM.

4-217. KLYSTRON COOLING. The heat energy from the high temperature areas in the klystron carriage is removed by a liquid ethylene-glycol-water solution circulated by the associated heat exchanger. The liquid coolant from the associated heat exchanger enters the 10-kw power amplifier through a coolant inlet valve (fig. 4-29). The greater portion of the coolant is pumped to the collector cooling assembly and the remainder of the coolant is fed to the series connected drift tube cooling assemblies on the klystron tube.

4-218. The coolant to the drift tube and the collector cooling assemblies flow through their related pressure switches, body flow switch 3A1S6 and collector flow switch 3A1S7 respectively. These switches act as protective devices and cut off the 10-kw power amplifier in the event of insufficient coolant flow through either branch.

4-219. As the coolant circulates, it absorbs heat generated by the collector and cavities of the klystron carriage. The pressure of the incoming coolant forces the hot coolant through the coolant outlet valve back to the associated heat exchanger to be cooled and recirculated.

4-220. SCAVENGER PUMP. A motor driven scavenger pump is provided to drain the coolant when maintenance to the klystron carriage is necessary. In the event that draining is required, the associated heat exchanger should be turned off, the coolant inlet valve closed, and the scavenger pump turned on. When the majority of the coolant is removed, the scavenger pump should be turned off, the klystron carriage should be removed from the cabinet, and the remaining coolant allowed to drain from the drain petcock.

4-221. AIR COOLING SYSTEM.

4-222. BLOWERS AND FANS. Two panel mounted and three internally mounted fans and one internally mounted blower provide the 10-kw power amplifier with forced air cooling. The two panel mounted fans, 3A2B1 and 3A2B2, located on distribution panel 3A2 provide intake air via a removable air filter. Cavity load fan 3A1B3, located in the lower front section of the klystron carriage, and circulating fan 3A1B2, located on the lower left side of the klystron carriage, provide cooling for the cavity loads and the other heat generating components on the klystron carriage. The klystron filament, the third cavity and the output cavity are air cooled by centrifugal blower 3A1B1. This blower is connected to the cooled components by flexible-tubing, air hose adaptors, and rigid ducts mounted on the klystron carriage frame.

4-223. Cabinet circulating fan 3B1, mounted on the interface between the power and amplifier cabinet sections, circulates the air in the upper portion of the 10-kw power amplifier.

4-224. AUTOMATIC DAMPER ASSEMBLY. The operation of the automatic damper assembly (fig. 4-30) regulates the air temperature within the 10-kw power amplifier cabinet. The interior cabinet air temperature is maintained and kept from rising by more than a given differential of 5°C (9°F). The damper assembly is in the right rear top of the 10-kw power amplifier cabinet as viewed from the front.

4-225. A rise in the cabinet air temperature above the ambient operating value is sensed by the heat detector of the thermostat, causing a plunger to lift from its housing. The plunger exerts an upward push on the control arm which is pivoted at one end of its mounting bracket and is eccentially coupled at the other end to a wheel. This wheel turns when the control arm is lifted by the plunger, thereby opening the slats of the automatic damper assembly. The opening of the slats allows the overheated cabinet air to escape and increases the interior air flow circulation for cooling. After cooling has taken place, the operation of the damper assembly is in the reverse order given above.

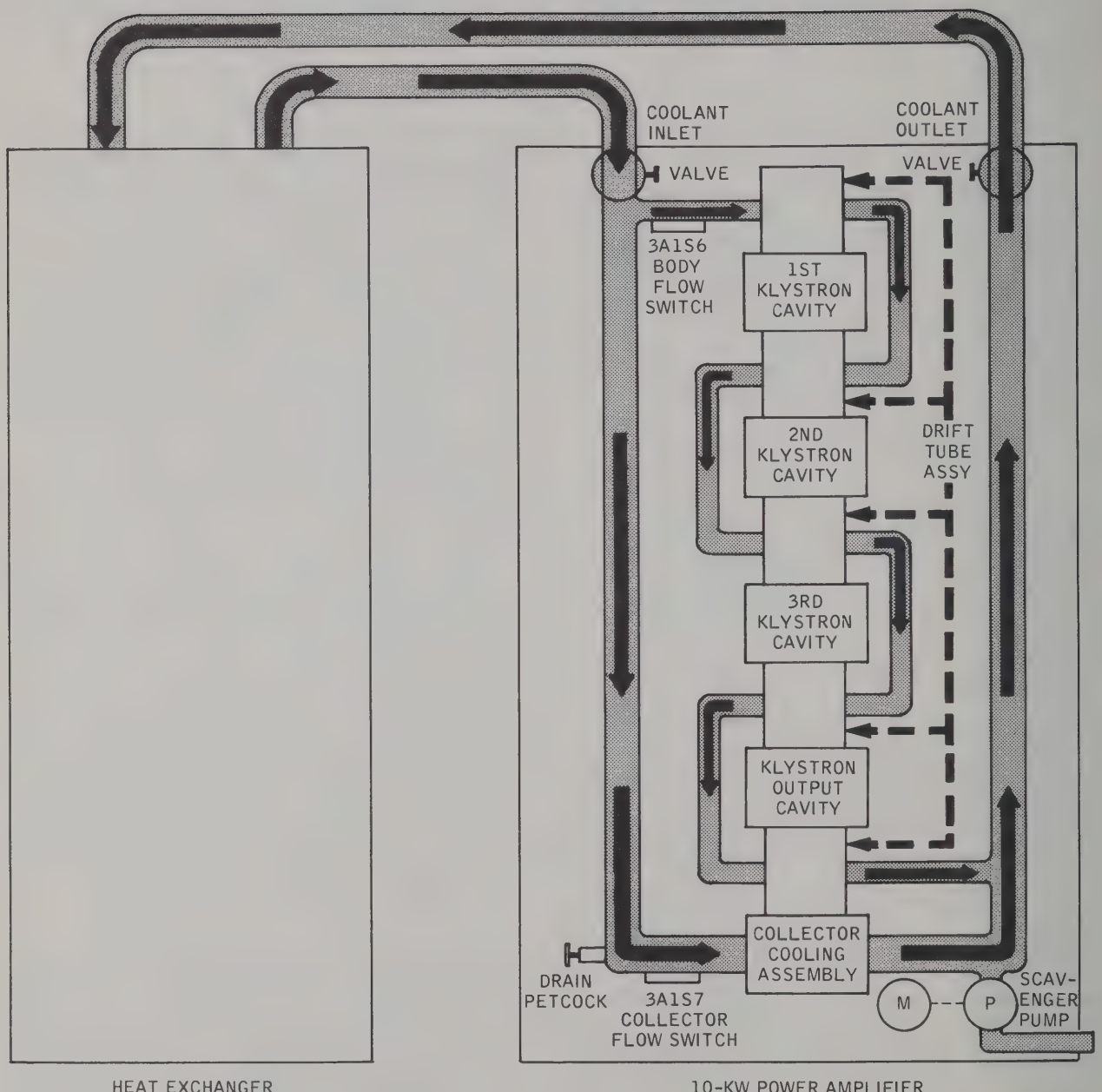

Figure 4-29. Liquid Cooling Flow, Functional Diagram

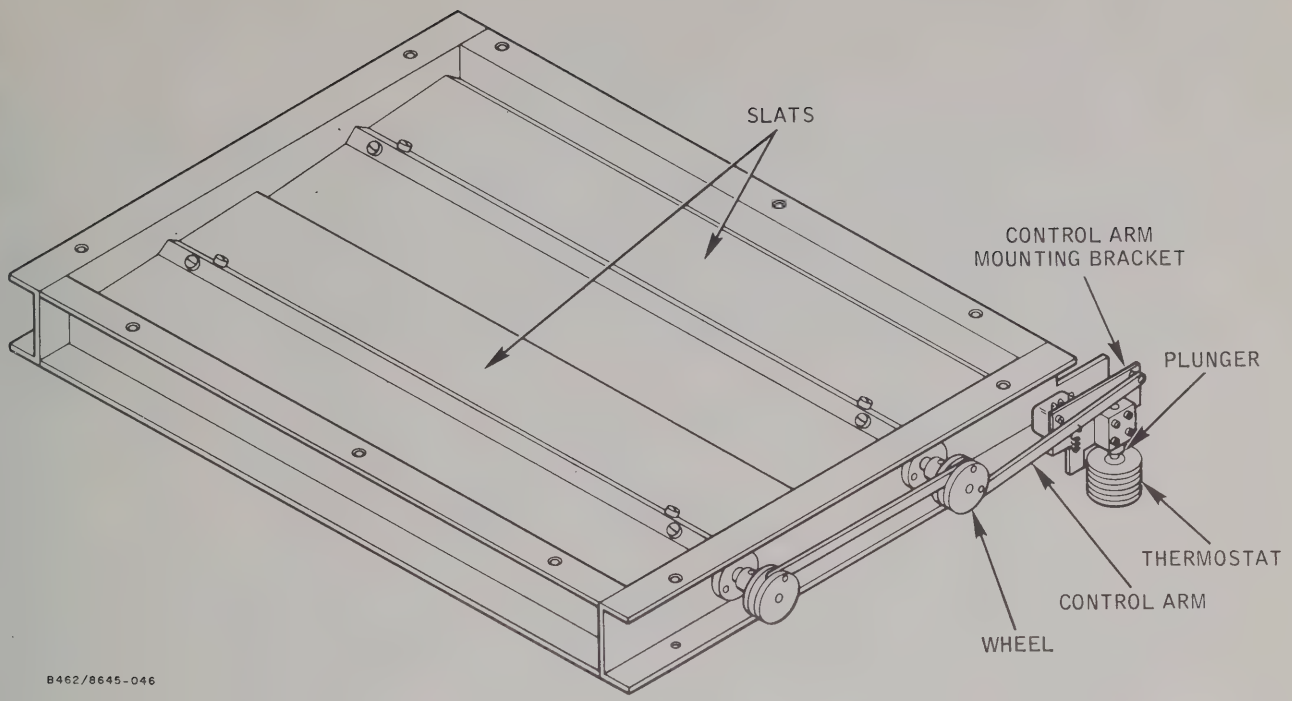

Figure 4-30. Automatic Damper Assembly

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CHAPTER 5

MAINTENANCE

5-1. INTRODUCTION. This chapter contains instructions needed to maintain the 10-kw power amplifier. Paragraphs 5.1-1 through 5.1-21 establish standardized work methods and simplified step-by-step instructions for preventive maintenance of this equipment. Paragraphs 5-2 through 5-48 contain organizational/field maintenance procedures which supplement those contained in paragraphs 5.1-1 through 5.1-21. Paragraphs 5-49 through 5-84 contain special maintenance data including removal and replacement and disassembly and reassembly procedures.

SECTION I.

PREVENTIVE MAINTENANCE

5.1-1. GENERAL. This section contains all routines which are required for the preventive maintenance of the 10-kw power amplifier. The instructions in section II of this chapter supplement these procedures. In performing the preventive maintenance according to these routines, refer to paragraphs 3-14 through 3-20.

5.1-2. PANEL METER CHECKS.

5.1-3. The purpose of this routine is to provide a procedure for determining that the 10-kw power amplifier is performing at optimum efficiency. No materials are required in this test. This routine is to be performed while the 10-kw power amplifier is operating with approximately 10-kw output.

a. Operate the LINE VOLTS switch on the ac control panel to the AB position. The LINE VOLTS meter on the ac control panel should read between 198 and 218 volts ac.

b. Operate the LINE VOLTS switch to the BC position. The LINE VOLTS meter should read between 198 and 218 volts ac.

c. Operate the LINE VOLTS switch to the AC position. The LINE VOLTS meter should read between 198 and 218 volts ac.

Note: The value obtained in a, b, and c above should not vary more than 10 volts of each other.

d. Operate the LINE VOLTS switch to the REG/UNREG position. Operate the REGULATED POWER circuit breaker on the ac control panel to the OFF position. The LINE VOLTS meter should read between 114 and 126 volts ac.

e. Operate the REGULATED POWER circuit breaker to the ON position. The LINE VOLTS meter should read between 118.8 and 121.2 volts ac.

f. Operate the LINE VOLTS switch to the CONTROL position. The LINE VOLTS meter should read between 114 and 126 volts ac.

g. Operate the LINE VOLTS switch to the OFF position.

h. Observe the KLYSTRON FIL CURRENT meter on the ac control panel. The indication should be between 37 and 43 amperes.

i. Observe the KLYSTRON FIL VOLTS meter on the ac control panel. The indication should be 7.5 volts ac.

j. Observe the BIAS VOLTAGE meter on the distribution panel. The indication should be between 300 and 200 volts dc.

k. Observe the BEAM VOLTS meter on the meter panel. The indication should be between 17 and 18 kv.

l. Observe the BEAM CURRENT meter on the meter panel. The indication should be between 1.9 and 2.0 amperes.

m. Observe the BODY CURRENT meter on the meter panel. The indication should be less than 100 ma.

n. Observe the PREFOCUS COIL CURRENT meter on the meter panel. The indication should be between 1.1 and 1.5 amperes.

o. Observe the FIELD COILS CURRENT meter on the meter panel. The indication should be between 3.0 and 4.0 amperes.

p. Operate the INPUT FORWARD-1ST CAVITY LOAD switch on the klystron carriage to the INPUT FORWARD position. The indication on the INPUT FORWARD-1ST CAVITY LOAD meter should be between 10 and 15 watts.

q. Observe the INPUT BACK meter on the klystron carriage. The indication should be approximately 0.01 watt. The maximum allowable reading is 0.8 percent of the indication obtained in p above.

r. Operate the INPUT FORWARD-1ST CAVITY LOAD switch on the klystron carriage to the 1ST CAVITY LOAD position. The indication on the INPUT FORWARD-1ST CAVITY LOAD meter should be approximately 6.0 watts. The minimum allowable reading is 50 percent of the indication obtained in p above.

s. Observe the OUTPUT FORWARD meter on the klystron carriage. The indication should be between 9 and 11 kw.

t. Observe the OUTPUT BACK meter on the klystron carriage. The indication should be less than 100 watts. The maximum allowable reading is 1 percent of the indication obtained in s above.

u. Observe the 2ND CAVITY LOAD meter on the klystron carriage. The indication should be between 50 and 120 watts.

v. Observe the 3RD CAVITY LOAD meter on the klystron carriage. The indication should be between 300,and 500 watts.

w. Observe the KLYSTRON COOLANT FLOW meter on the klystron carriage. The indication should be between 18 and 30 gallons per minute.

5.1-4. VSWR CHECK.

5.1-5. The purpose of this routine is to provide a procedure for determining that the voltage standing wave ratio (vswr) for the input and the output of the 10-kw power amplifier is within specified limits. No materials are required for this test. This routine is to be performed while the 10-kw power amplifier is operating with approximately 10-kw output.

a. Operate the INPUT FORWARD-1ST CAVITY LOAD switch on the klystron carriage to the INPUT FORWARD position.

b. Operate the TUNE-FS2 WATTS switch on the klystron carriage to the FS2 WATTS position.

c. Record the indications observed on the INPUT BACK meter and the INPUT FORWARD-1ST CAVITY LOAD meter on the klystron carriage.

d. Divide the recorded indication observed on the INPUT BACK meter by the recorder indication observed on the INPUT FORWARD-1ST CAVITY LOAD meter and multiply by 100. Record the result.

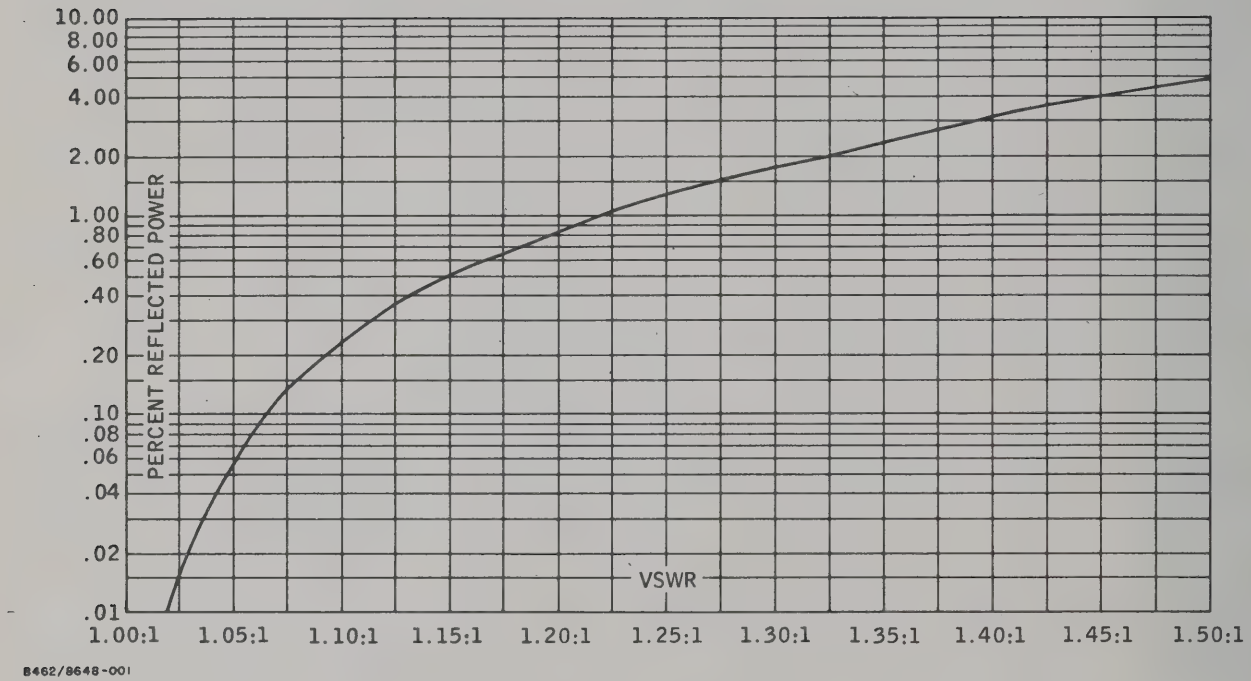

Figure-5.1-1. Percent of Reflected Power Versus VSWR.

Note: The value recorded in d above represents the percent reflected power present at the input to the 10-kw power amplifier.

e. On the left side of the graph in figure 5.1-1, locate the percent reflected power recorded in d above. From this point, follow horizontally to the right until intersecting the curved line. From the point of intersection, follow vertically down to the bottom line of the graph. The point of intersection on the bottom line represents the vswr for the input to the 10-kw power amplifier and should be less than 1.2:1.

f. Record the indications observed on the OUTPUT FORWARD meter and the OUTPUT BACK meter on the klystron carriage.

g. Divide the recorded indication observed on the OUTPUT BACK meter by the recorded indication observed on the OUTPUT FORWARD meter and multiply by 100. Record the result.

Note: The value recorded in g above represents the percent reflected power present at the output of the 10-kw power amplifier.

h. On the left side of the graph in figure 5.1-1 locate the percent reflected power recorded in g above. From this point, follow horizontally to the right until intersecting the curved line. From the point of intersection, follow vertically down to the bottom line of the graph. The point of intersection on the bottom line represents the vswr for the output of the 10-kw power amplifier and should be less than 1.5:1.

5.1-6. FAULT RECYCLING CIRCUIT CHECK.

5.1-7. The purpose of this routine is to provide a procedure for determining that the 10-kw power amplifier beam voltage is properly interrupted and recycled when a fault occurs. This routine is to be performed while the 10-kw power amplifier is operating with approximately 10-kw output. The time required for the recycling circuit to function (recycle time) depends on the duration of main power shutoff and can be calculated as follows:

If main power is off:	Recycle time is:
Less than 2.5 seconds	Immediate
2.5 seconds or more	5 minutes

A screwdriver, one-fourth inch, is used in this test.

a. Operate the AUTOMATIC-NORMAL-RESET switch on the ac control panel to the AUTOMATIC position.

b. Operate the MAIN POWER circuit breaker on the distribution panel to the OFF position. Within 2.5 seconds, operate the MAIN POWER circuit breaker back to the ON position. Observe that the indication on the BEAM VOLTS meter on the meter panel drops to zero for the length of time that the MAIN POWER circuit breaker is in the OFF position and then returns to its previous position when the MAIN POWER circuit breaker is operated to the ON position.

c. Operate the MAIN POWER circuit breaker on the distribution panel to the OFF position. After approximately 10 seconds, operate the MAIN POWER circuit breaker to the ON position. Observe that the BEAM VOLTS meter drops to zero and returns to normal indication after approximately 5 minutes.

d. Use the screwdriver to adjust the red pointer of the BODY CURRENT meter on the meter panel so that it contacts the black pointer. Within 2.5 seconds, return the red pointer to its previous position. The black pointer should remain in contact with the red pointer. Observe that the BEAM VOLTS meter indication drops to zero for the length of time (less than 2.5 seconds) that the red pointer on the BODY CURRENT meter is moved from its original position. Also, observe that the black pointer separates from the red pointer and returns to its original position.

e. Within 5 minutes of performing d above, move the red pointer on the BODY CURRENT meter so that it contacts the black pointer. After 10 seconds, return the red pointer to its previous position. Observe that the BEAM VOLTS meter indication drops to zero and that the black pointer remains in contact with the red pointer on the BODY CURRENT METER. Observe that after approximately 5 minutes the BEAM VOLTS meter indication returns to its previous position and that the black pointer separates from the red pointer on the BODY CURRENT meter and returns to its previous position.

f. Open the interlock circuit by opening the meter panel. Close the meter panel within 2.5 seconds. Observe that the indication on the BEAM VOLTS meter drops to zero for the length of time (less than 2.5 seconds) that the meter panel is open and then returns to the normal indication when the meter panel is closed.

g. Within 5 minutes of performing f above, open the meter panel. After 10 seconds close the meter panel. Observe that the indication on the BEAM VOLTS meter drops to zero. Observe that the BEAM VOLTS meter indication returns to its previous indication approximately 5 minutes after the panel or door is closed.

h. Use the screwdriver to adjust the red pointer of the OUTPUT FORWARD meter on the klystron carriage so that the red pointer contacts the black pointer. Return the red pointer to its previous position. The black pointer should remain in contact with the red pointer.

i. Operate the RESET-NORMAL-AUTOMATIC switch on the ac control panel to the RESET position and then to the AUTOMATIC position. Observe that the black pointer of the OUTPUT FORWARD meter is released from the red pointer, and returns to its previous indication.

5.1-8. PROTECTIVE AND ALARM SYSTEM CHECK.

5.1-9. The purpose of this routine is to provide a procedure for checking the protective and alarm system by manually introducing faults. A one-fourth inch screwdriver is used in this test. This routine is to be performed while the 10-kw power amplifier is operating with approximately a 10-kw output.

a. Use the screwdriver to adjust the red pointer of the OUTPUT BACK meter on the klystron carriage so that it makes contact with the black pointer. Return the red pointer to its original position.

b. Check to see that the HIGH VSWR lamp on the meter panel goes on.

Note: The OUTPUT BACK meter should make a scale change.

c. Repeat a above and check to see that the VERY HIGH VSWR lamp on the meter panel goes on.

Note: The BEAM VOLTS meter on the meter panel should indicate 0 volt.

d. Momentarily operate the RESET-NORMAL-AUTOMATIC switch on the ac control panel to the RESET position.

e. Use the screwdriver to adjust the red pointer of the OUTPUT FORWARD meter on the klystron carriage until it makes contact with the black pointer, and then return the red pointer to its original position. The black pointer should remain in contact with the red pointer.

f. See that the LOW FWD POWER lamp on the meter panel goes on.

g. Perform d above. The black pointer should separate from the red pointer.

h. Use the screwdriver to adjust the red pointer of the BODY CURRENT meter on the meter panel until it makes contact with the black pointer, and then return the red pointer to its original position. The black pointer should remain in contact with the red pointer.

i. See that the BODY OVERLOAD lamp on the ac control panel goes on.

j. Perform d above. The black pointer should separate from the red pointer.

k. Operate the ALARM POWER circuit breaker on the ac control panel to the OFF position.

l. See that the ALARM PS FAILURE lamp on the ac control panel goes on.

m. Operate the ALARM POWER circuit breaker to the ON position.

n. Operate the REGULATED POWER circuit breaker on the ac control panel to the OFF position.

o. Check to see that the FIL UNREG lamp on the ac control panel goes on.

p. Operate the REGULATED POWER circuit breaker to the ON position.

q. Rotate the CALIBRATE control on the 120-volt regulator control panel until the FIL REG LIMIT lamp on the ac control panel goes on. Rotate the CALIBRATE control back to its original position and observe that the FIL REG LIMIT lamp goes off.

r. Turn the four turn-fasteners that hold the 120-volt regulator control panel in place to the left. Pull the 120-volt regulator control panel out and disconnect the plug on the rear.

s. Check to see that the PANEL OUT lamp on the ac control panel goes on.

t. Connect the plug on the rear of the 120-volt regulator control panel. Observe that the PANEL OUT lamp goes off.

u. Replace the 120-volt regulator control panel in its mounting location.

v. Repeat r, s, t, and u for each of the following: field coils regulator control panel, beam regulator control panel, and alarm power supply.

5.1-10. TRANSFORMER SILICA-GEL CHECK.

5.1-11. The purpose of this routine is to provide a procedure for checking the silica-gel on the beam power supply for moisture absorption. No materials are required in this test.

a. Perform the turnoff procedure as outlined in paragraphs 3-16 through 3-20.

b. Release the two fasteners that secure the hinged ac control panel and swing the ac control panel to the right.

Warning: Lethal potentials are present at the anodes of the six rectifier tubes of the beam power supply. The anodes must be grounded before working inside the amplifier cabinet.

c. Use the grounding rod to ground the anodes of the six rectifier tubes mounted on top of the beam power supply.

d. Observe the color of the silica-gel in the breather tank located on the beam power supply. The silica-gel should be blue. That portion of the silica-gel that has absorbed moisture will be pink and must be replaced.

e. Close and secure the ac control panel.

f. Perform the turnon procedure as outlined in paragraphs 3-14 through 3-20.

5.1-12. 10-KW POWER AMPLIFIER CLEANING AND INSPECTION PROCEDURE.

5.1-13. The purpose of this routine is to provide a procedure for cleaning and inspecting the 10-kw power amplifier. The materials required include a cleaning cloth, a vacuum cleaner, solvent Fed Spec P-S-661, and a one-fourth inch screwdriver.

a. Perform the turnoff procedure as outlined in paragraphs 3-16 through 3-20.

b. Remove all dust and foreign matter from the top of the amplifier cabinet with a vacuum cleaner.

Warning: Lethal voltages are present inside the amplifier cabinet. Discharge all exposed high-voltage lines with grounding rod before working in the amplifier cabinet. Use extreme caution to avoid burns when working near high power resistors.

c. Open the hinged panels for access to the interior of the amplifier cabinet.

d. Clean all dust and dirt from the interior of the amplifier cabinet.

e. Where space is limited, use the vacuum cleaner as a blower to dislodge dirt and foreign matter.

f. Inspect wires and cables for damaged insulation, kinking or twisting, and loose or damaged cable clamps.

g. Inspect terminal boards for cracks, loose terminals, and insecure mounting.

h. Inspect interlocks for damaged or broken connections, misalignment or jamming, and insecure mounting.

i. Inspect klystron cavities for dents.

j. Inspect resistors for cracks, chipping, broken leads, discoloration, and blistering due to overheating and insecure mounting.

k. Inspect capacitors for bulging, melted wax, and insecure mounting.

l. Inspect transformers and chokes for signs of leaking tar and overheating, loose connections, and insecure mounting.

m. If excess grease or oil has accumulated at motors, gears, or shaft bearings, remove it with the cleaning cloth.

Warning: Prolonged contact of skin with cleaning solvent or inhalation of fumes is dangerous. Adequate ventilation is required.

n. Remove corrosion and hardened grease with solvent and cleaning cloth.

o. Inspect the coolant system lines for leakage.

p. Close and fasten hinged panels.

Caution: Do not disturb the adjustments of panel controls during the performance of this routine.

q. Inspect the 10-kw power amplifier exterior for signs of rust, corrosion, missing or loose holding screws, and chipped paint.

r. Inspect all circuit breakers and toggle switches for insecure mounting or improper switching action.

s. Inspect indicator lamps for damaged sockets, damaged or missing lenses, and insecure mounting.

t. Inspect panelmeters for broken or missing glass and damaged or frozen indicators.

u. Inspect meter glasses for cleanliness. Clean with a damp cloth if necessary.

Caution: Do not clean meter glasses unless it is absolutely necessary. Some meter glasses are coated with an antistatic solution; frequent rubbing could remove the solution, causing the meter to function erratically.

v. Perform the turnon procedure as outlined in paragraphs 3-14 through 3-20.

w. Remove dust and foreign matter from all work areas in front of the 10-kw power amplifier with the vacuum cleaner.

5.1-14. AIR FILTER CLEANING PROCEDURE.

5.1-15. The purpose of this routine is to provide a procedure for cleaning the three front panel-mounted air filters of the 10-kw power amplifier. The materials required include a vacuum cleaner, a one-fourth inch screwdriver, a garden hose with a pressure nozzle, motor lubricating oil as required, a clean, lint-free cloth, and a container for immersing the filter.

a. Perform the turnoff procedure as outlined in paragraphs 3-16 through 3-20.

b. Remove all dust from the front surface and grille of each air filter assembly with a vacuum cleaner.

c. Remove screws holding the metal grilles. Place screws in a safe place to prevent loss.

d. Remove the metal grilles.

e. Remove the air filters from the air filter assemblies.

f. Install new or clean filters in the air filter assemblies with the airflow arrows pointing inward.

g. Replace the metal grilles and screws.

h. Perform the turnon procedure as outlined in paragraphs 3-14 through 3-20.

Note: Perform the following procedures on the removed dirty filters. When the filters are excessively dirty, presoak them in a water and soap solution.

i. Use the garden hose to direct a stream of water to the dirty side of the filter. Use of hot water will speed the cleaning operation.

j. Continue to apply water until the dirt mass has broken loose from the mesh and has been flushed through the herringbone-crimped channels.

k. Allow filters to drain until dry.

l. Fill a suitable container with the recommended motor lubricating oil. The following lubricants are recommended for use on the filters when the ambient temperature is as indicated:

Ambient temperature	SAE viscosity
75° to 130°F	60
40° to 75°F	30
Below 40°F	10 W

m. Completely immerse the filter in the oil. Allow the filter to remain in the oil until bubbles stop rising to the surface.

n. Remove the filter from the oil.

o. Stand the filter on edge with the drain holes down. Allow the filters to drain at a temperature above 70° F for 12 to 25 hours, or until excess oil has drained from the filter.

p. Wipe excess oil from the outer frames of the filter with the clean, lint-free cloth.

5.1-16. KLYSTRON CARRIAGE LUBRICATION.

5.1-17. The purpose of this routine is to provide a procedure for lubricating the moving parts of the klystron carriage. Do not disturb control settings while performing this routine. Two men are required to perform this routine. The materials required include lubricating grease, MIL-L-2105 or equivalent, lightweight oil (SAE 10), a hand oiler, and a lint-free cleaning cloth.

a. Perform the turnoff procedure as outlined in paragraphs 3-16 through 3-20.

b. Loosen the two knurled knobs on the meter panel. Swing the meter panel open, raising it until the locking-bar catches.

Warning: Lethal voltages are present at the klystron (Amplifier, Radio Frequency AM-2752/FRC-39A(V) or AM-3629/MRC-98) which could inflict serious injury or death. Excercise extreme care when grounding high-voltage circuits.

c. Ground the three high-voltage terminals (fig. 2-22) with the grounding rod.

d. Loosen the three wingnuts on high-voltage terminal board TB1 (fig. 2-22). Remove terminal board TB1 from terminal board TB10 by sliding terminal board TB1 to the left.

e. Disconnect plug P9, on coaxial cable 3W2, from the input of directional coupler DC1 (fig. 2-22 and 2-16).

f. Disconnect the two quick-fit coolant fittings (fig. 2-16) by pulling straight forward (toward the front of the klystron carriage) on the quick-fit coolant fittings.

g. Disconnect the quick-fit scavenger pump hose connection (fig. 2-16).

h. Disconnect plug P1 from jack J1 and plug P2 from jack J2 (fig. 2-16).

i. Loosen the two coupling clamps on the transmission line (fig. 2-16) and slide the outer shield up.

j. Use the two spanner wrenches provided on the top of the klystron carriage to loosen and separate the two bullet connectors by holding the lower bullet connector and rotating the upper bullet connector counterclockwise.

Caution: Do not rotate the lower bullet connector because the output of the klystron would be detuned.

k. Raise the hinged wheel cover at the bottom of the klystron carriage and install the two ramp assemblies at the base of the amplifier cabinet.

Caution: Removal of the klystron carriage is always a two-man operation. Take care not to move chains or otherwise disturb the control settings. If the klystron carriage is to be removed within a mobile installation (such as Radio Set AN/MRC-85), it must be rolled onto a dolly. Use extreme care when rolling a klystron carriage onto a dolly to avoid damage to the various fittings on the klystron carriage.

l. Loosen the two knurled knobs on the handles of the klystron carriage.

m. Carefully roll the klystron carriage out of the amplifier cabinet.

n. Apply grease lightly to the coupler drive shafts, sprockets, gears, and chains (fig. 2-19).

o. Apply grease lightly to the cavity sprockets, gears, and chains.

p. If the 1ST, 2ND, 3RD, OUTPUT, or INPUT TUNING control handcrank; or the OUTPUT COUPLING ADJUST handcrank is stiff in movement, lubricate with oil (through klystron carriage front panel); use the hand oiler.

q. Use the hand oiler to lubricate the wheels of the klystron carriage.

r. Carefully roll the klystron carriage into the amplifier cabinet.

s. Tighten the two knurled knobs on the handles of the klystron carriage.

t. Remove the two ramp assemblies at the base of the amplifier cabinet.

u. Use the spanner wrenches to connect the two bullet connectors together by holding the lower bullet connector stationery and rotating the upper bullet connector clockwise.

v. Slide the outer shield on the transmission line down and tighten the two coupling clamps.

w. Connect jack J1 to plug P1 and jack J2 to plug P2.

x. Connect the scavenger pump quick-fit hose connection by pushing the quick-fit fittings together.

y. Connect the two quick-fit coolant fittings.

z. Connect plug P9, on coaxial cable 3W2, to the input of directional coupler DC1.

aa. Connect terminal board TB1 to terminal board TB10 by sliding terminal board TB1 to the right. Tighten the three wingnuts on terminal board TB1.

ab. Close the meter panel and tighten the two knurled knobs.

ac. Perform the turnon procedure as outlined in paragraphs 3-14 through 3-20.

5.1-18. REPLACEMENT OF SILICA-GEL.

5.1-19. The purpose of this routine is to provide a procedure for replacing the silica-gel in the breather tank of the beam power supply. The materials required include a dry, lint-free cleaning cloth, an adjustable open-end wrench, and approximately 5 pounds of silica-gel, 85-15 blend, Eagle Chemical Company, Chicago, Illinois.

a. Perform the turnoff procedure as outlined in paragraphs 3-16 through 3-20.

b. Release the two fasteners that secure the hinged ac control panel and swing the ac control panel to the right.

Warning: Lethal potentials are present at the anodes of the six rectifier tubes of the beam power supply. The anodes must be grounded before working inside the amplifier cabinet.

c. Use the grounding rod to ground the anodes of the six rectifier tubes mounted on top of the beam power supply.

d. Close the one-fourth inch shutoff valve near the upper front of the beam power supply (fig. 5-4).

e. Disconnect the one-fourth inch tubing elbow from the bottom of the breather tank.

f. Remove the clamps from the breather tank.

g. Remove the top cover from the breather tank and discard the old silica-gel.

h. Dry out the breather tank with the cleaning cloth and refill the tank with the silica-gel.

i. Install the top cover on the breather tank and reconnect the tubing and clamps.

j. Open the one-fourth inch shutoff valve.

k. Close and secure the ac control panel by connecting the two fasteners.

l. Perform the turnon procedure as outlined in paragraphs 3-14 through 3-20.

5.1-20. CLEANING AND LUBRICATION OF VARIABLE AUTOTRANSFORMERS.

5.1-21. The purpose of this routine is to provide a procedure for cleaning and lubricating the variable autotransformers of the beam power primary control, the 120-volt regulator autotransformer subassembly, the field coils variable autotransformer, and the prefocus coils current adjust variable transformer. Do not disturb the control settings while performing this routine. Two men are required to perform this routine. The materials required include a dry, soft-bristled brush, lubricating oil, Stanoil No. 35 (Standard Oil Company of Indiana) or equivalent high quality SAE 30 weight oil, and a clean, dry cloth. Refer to paragraph 5.1-16 while performing this procedure.

a. Perform the turnoff procedure as outlined in paragraphs 3-16 through 3-20.

b. Loosen the two knurled knobs on the meter panel. Swing the meter panel open, raising it until the locking-bar catches.

Warning: Lethal voltages are present at the klystron carriage which could inflict serious injury or death. Excercise extreme care when grounding high-voltage circuits.

c. Ground the three high-voltage terminals (fig. 2-22) with the grounding rod.

d. Loosen the three wingnuts on high-voltage terminal board TB1 (fig. 2-22). Remove terminal board TB1 from terminal board TB10 by sliding terminal board TB1 to the left.

e. Disconnect plug P9, on coaxial cable 3W2, from the input of directional coupler DC1 (fig. 2-16).

f. Disconnect the two quick-fit coolant fittings (fig. 2-16) by pulling straight forward (toward the front of the klystron carriage) on the quick-fit coolant fittings.

g. Disconnect plug P1 from jack J1 and plug P2 from jack J2 (fig. 2-16).

h. Loosen the two coupling clamps on the transmission line (fig. 2-19) and slide the outer shield up.

i. Use the two spanner wrenches provided on the top of the klystron carriage to loosen and separate the two bullet connectors by holding the lower bullet connector and rotating the upper bullet connector counterclockwise.

Caution: Do not rotate the lower bullet connector because the output of the klystron would be detuned.

j. Raise the hinged wheel cover at the bottom of the klystron carriage and install the two ramp assemblies at the base of the amplifier cabinet.

Caution: Removal of the klystron carriage is always a two-man operation. Take care not to move chains or otherwise disturb the control settings. If the klystron carriage is to be removed within a mobile installation (such as Radio Set AN/MRC-85), it must be rolled onto a dolly. Use extreme care when rolling a klystron carriage onto a dolly to avoid damage to the various fittings on the klystron carriage.

k. Loosen the two knurled knobs on the handles of the klystron carriage.

l. Carefully roll the klystron carriage out of the amplifier cabinet.

m. Release the two fasterers that secure the hinged ac control panel and swing the ac control panel to the right.

n. Use the brush to remove all dirt from the beam power primary control (fig. 2-3).

o. Place 6 drops of oil in each oilhole or port in the beam power primary control drive motor and gearbox.

p. Use the cloth to wipe off all spilled oil and grease.

q. Use the brush to remove all dirt from the field coils variable autotransformer (fig. 2-3).

r. Place 6 drops of oil in each oilhole or port in the field coils variable autotransformer drive motor and gearbox.

s. Use the cloth to wipe off all spilled oil and grease.

t. Use the brush to remove all dirt from the variable autotransformer (PREFOCUS COIL CURRENT ADJUST) on the klystron carriage.

u. Use the brush to remove all dirt from the variable autotransformer (KLYSTRON FIL VOLTS ADJUST) on the ac control panel.

v. Close the ac control panel and secure the two fasteners.

w. Carefully roll the klystron carriage into the amplifier cabinet.

x. Tighten the two knurled knobs on the handles of the klystron carriage.

y. Remove the two ramp assemblies at the base of the amplifier cabinet.

z. Use the two spanner wrenches to connect the two bullet connectors together by holding the lower bullet connector stationary and rotating the upper bullet connector clockwise.

aa. Slide the outer shield on the transmission line down and tighten the two coupling clamps.

ab. Connect jack J1 to plug P1 and jack J2 to plug P2.

ac. Connect the scavenger pump quick-fit hose connection by pushing the quick-fit fittings together.

ad. Connect the two quick-fit hose connection by pushing the quick-fit fittings together.

ae. Connect plug P9, on coaxial cable 3W2, to the input of directional coupler DC1.

af. Connect high-voltage terminal board TB1 to terminal board TB10 by sliding terminal board TB1 to the right. Tighten the three wingnuts on terminal board TB1.

ag. Close the meter panel and tighten the two knurled knobs.

ah. Perform the turnon procedure as outlined in paragraphs 3-10 through 3-20.

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SECTION II
ORGANIZATIONAL/FIELD MAINTENANCE

5-2. GENERAL.

5-3. This section contains all data required for maintenance of the 10-kw power amplifier at an organizational/field level. These instructions supplement the procedures contained in the preventive maintenance workcards. In performing organizational/field maintenance according to these instructions, reference should be made to chapter 6 and TM 11-5820-757-25P.

5-4. TEST EQUIPMENT.

5-5. All of the test equipment required for organizational/field maintenance is listed in table 5-1. The test equipment operation characteristics given in table 5-1 are those which are applicable to the testing of this equipment, and do not necessarily represent the maximum capabilities of the test equipment.

5-6. PERFORMANCE TEST STANDARDS.

5-7. The 10-kw power amplifier is provided with front panel-mounted meters which monitor all power and rf circuits. In addition, indicator lamps are provided to indicate low power output, extreme low power output, and high or excessive vswr. Due to the fact that these meters and indicator lamps are checked frequently during routine operation and maintenance, no performance tests are given in this manual. Performance tests are covered by the preventive maintenance workcards.

5-8. TEST POINTS.

5-9. The 10-kw power amplifier is provided with test points as an aid in aligning and maintaining the equipment. Table 5-2 lists all test points, their locations, and circuit functions. Figures 5-1 and 5-2 illustrate all test points which are not front panel mounted.

5-10. DC VOLTAGE REQUIREMENTS AND SOURCES.

5-11. Table 5-3 lists the dc operating voltages for components of the 10-kw power amplifier.

5-12. PREVENTIVE MAINTENANCE.

5-13. Routine maintenance procedures designed to detect and help prevent troubles before equipment operation is seriously impaired are contained in section 1 of this chapter.

Table 5-1. Test Equipment

Test Equipment		Required Characteristics
Common Name	Official Nomenclature	
UHF signal generator	Generator, Signal AN/URM-49( )	Frequency range: 700 to 1000 mc ±1% Power range: 0.5 to 5 mw Output impedance: 50 ohms
Microwave power meter (with associated bolometer mount)	Wattmeter, Microwave Power TS-779/U (with Bolometer RF, MX-2144A/U)	Frequency range: 700 to 1000 mc Power range: 0.5 to 5 mw Accuracy: ±5%
Multimeter	Multimeter AN/PSM-6(-)	Frequency range: 0 to 100 cps Voltage range: 0 to 250 vac; 0 to 500 vdc Current range: 0 to 500 ma Resistance range: 0 to 10 megohms Sensitivity, ac: 1000 ohms per volt Sensitivity, dc: 20,000 ohms per volt Accuracy: ±4%

Table 5-2. Test Points

Location	Reference Designation	Circuit Function
Klystron carriage	3A1J6	SCOPE JACK, allows monitoring of cavity sample selected by CAVITY SELECTOR switch 3A1S5
	3A1J7	Allows measurement of voltage supplied by winding 3A6T1-A (phase A) of field coils variable autotransformer
	3A1J8	Allows measurement of voltage supplied by winding 3A6T1-B (phase B) of field coils variable autotransformer
	3A1J9	Allows measurement of voltage supplied by winding 3A6T1-C (phase C) of field coils variable autotransformer
	3A1J10-3A1J11	Allows measurement of voltage across field coils
	3A1J12-3A1J13	Allows measurement of voltage across prefocus coil
AC control panel	3A3J1	Neutral
	3A3J2	Used to check activation of prefocus coil overload relay 3A3K14
	3A3J3	Used to check activation of field coils interlock relay 3A3K13
	3A3J4	Used to check activation of beam overload relay 3K1
	3A3J5	Used to check activation of time delay 0.8 to 2.5 second relay 3A3K2
	3A3J6	Used to check activation of beam control relay 3A3K5
	3A3J7	Used to check activation of time delay 0.5 to 1.0 second relay 3A3K1
	3A3J8	Used to check activation of ac power failure detector relay 3A3K10
	3A3J9	Used to check activation of cabinet air cooling relay 3A3K17
	3A3J10	Used to check activation of getter-filament prefocus control relay 3A3K9
	3A3J11	Used to check activation of time delay 3 second relay 3A3K8
	3A3J12	Used to check activation of beam step control relay 3A3K12
	3A3J13	Used to check activation of recycle cutout relay 3A3K11
	3A3J14	Used to check activation of temperature control relay 3A3K16

Table 5-2. Test Points (cont)

Location	Reference Designation	Circuit Function
AC control panel (cont)	3A3J15	Used to check activation of beam control relay 3A3K15
	3A3J16	Used to check closure of filament on switch 3A3S5 (activated by KLYSTRON FIL VOLTS ADJUST control)
120-volt regulator control panel (fig. 5-1)	3A3A1J1	Raise voltage to bridge circuit of relay 3A3A1K2
	3A3A1J2	Lower voltage to bridge circuit of relay 3A3A1K3
	3A3A1J3	Negative side of rectified and filtered 120 vac sample voltage
	3A3A1J4 (to 3A3A1J3)	Reference voltage across zener diode 3A3A1CR5
	3A3A1J5	Positive side of rectified and filtered 120 vac sample voltage
	3A3A1J6	Neutral
	3A3A1J7	Control voltage to lower output of motor-driven autotransformer 3A5A1T1
	3A3A1J8	Input ac motor control voltage
	3A3A1J9	Control voltage to raise output of motor-driven autotransformer 3A5A1T1
Field coils regulator control panel (fig. 5-2)	3A3A2J1	Raise voltage to bridge circuit of relay 3A3A2K2
	3A3A2J2	Lower voltage to bridge circuit of relay 3A3A2K3
	3A3A2J3	Negative side of dc sample voltage
	3A3A2J4 (to 3A3A2J3)	Reference voltage across zener diode 3A3A2CR1
	3A3A2J6	Neutral
	3A3A2J7	Control voltage to lower output of motor-driven autotransformer 3A6T1
	3A3A2J8	Input ac motor control voltage
	3A3A2J9	Control voltage to raise output of motor-driven autotransformer 3A6T1
Alarm power supply	3A3A3J1	Power supply output voltage
	3A3A3J2	Ground
	3A3A3J3	
	3A3A3J4	Ac input to bridge rectifier
Beam regulator control panel (fig. 5-1)	3A3A4J1	Raise voltage to bridge circuit of relay 3A3A4K2
	3A3A4J2	Lower voltage to bridge circuit of relay 3A3A4K3
	3A3A4J3	Negative side of rectified and filtered ac sample voltage
	3A3A4J4	Reference voltage across zener diode 3A3A2CR7
	3A3A4J5	Positive side of rectified and filtered ac sample voltage
	3A3A4J6	Neutral
	3A3A4J7	Control voltage to lower output of motor-driven autotransformers 3A5T2 and 3A5T3
	3A3A4J8	Input ac motor control voltage
	3A3A4J9	Control voltage to raise output of motor-driven autotransformers 3A5T2 and 3A5T3

Table 5-3. DC Voltage Requirements and Sources

Component	DC Operating Voltage	Sources
Klystron tube	-17,000	Beam power supply
Prefocus coil	0 to +30	Focus coils power supply 3A7
Field coils	+250 to +400	Focus coils power supply 3A7
Meter panel 3A4	+100	Alarm power supply 3A3A3

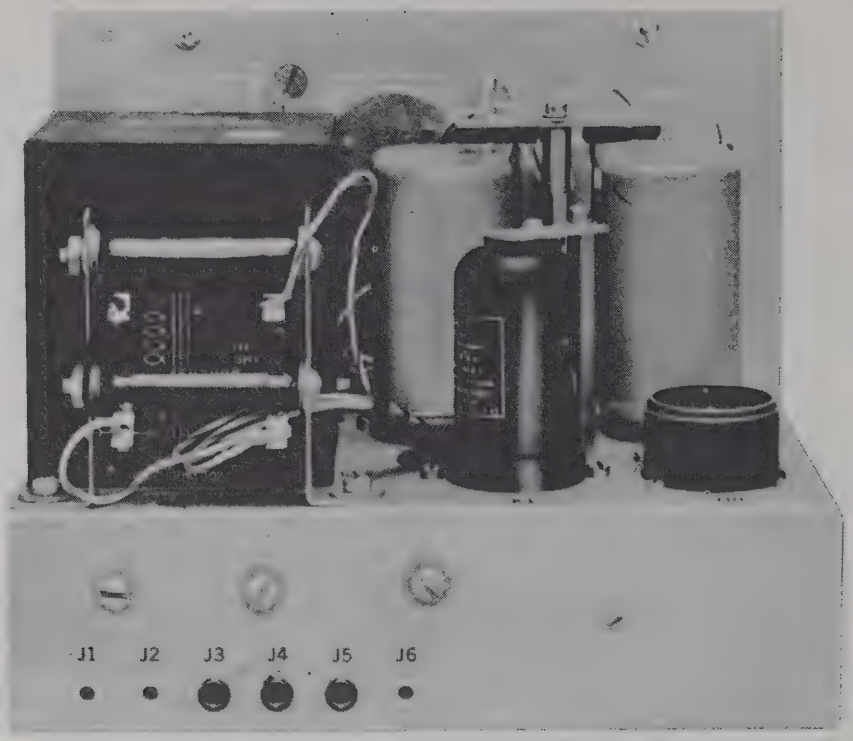

Figure 5-1. 120-volt Regulator Control Panel or Beam Regulator Control Panel, Rear View

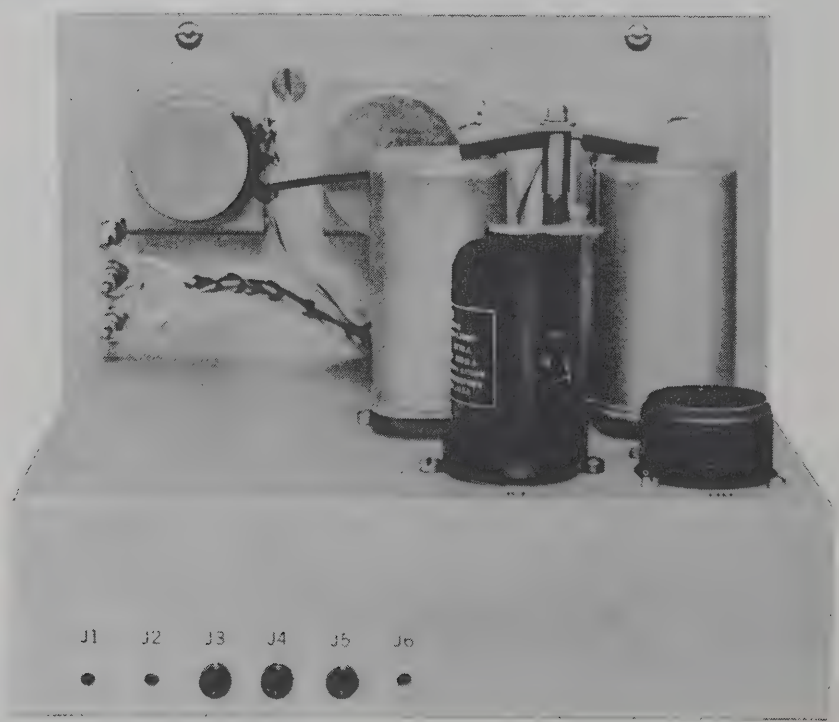

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Figure 5-2. Field Coils Regulator Control Panel, Rear View

5-14. TROUBLESHOOTING.

WARNING

Approximately 17,000 volts are present when the 10-kw power amplifier is energized. Make certain that all power is disconnected and that the high voltage circuits are grounded before entering the 10-kw power amplifier. Discharge filter capacitors and ground all exposed terminals with the grounding rod provided. At least two men, thoroughly trained in the procedures used in treating electric shock, are required when servicing the equipment.

5-15. A fault indicator data chart, table 5-4, is provided to aid you in locating and correcting some of the troubles which may develop in the 10-kw power amplifier. Obviously, this chart cannot cover all possible troubles that may occur; if a specific trouble is not covered, isolate the assembly in which the trouble occurred and then locate the defective component using standard troubleshooting techniques.

5-16. The information contained in table 5-4 assumes that the 10-kw power amplifier was operating correctly just prior to the malfunction, and that all indicator lamps are in serviceable condition.

5-17. ALIGNMENT AND ADJUSTMENT.

5-18. GENERAL.

5-19. The procedures contained herein will enable you to perform all adjustments and alignments necessary after installation, repair, or replacement of a component, frequency change, equipment shutdown in excess of 1 hour, or whenever adjustment and tuning controls have been changed. It is assumed that the 10-kw power amplifier has been properly installed as described in Chapter 2 of this manual, and that all wiring and rf connections have been checked and found to be in accordance with applicable wiring diagrams contained in chapter 6.

5-20. CALIBRATION OF RF METERS.

5-21. The rf meters used with the 10-kw power amplifier are frequency sensitive. They should be calibrated at the time of initial installation, after repairs to the meter circuits, and whenever the operating frequency is changed.

5-22. CALIBRATION OF INPUT FORWARD - 1ST CAVITY LOAD METER. To calibrate the INPUT FORWARD - 1ST CAVITY LOAD meter proceed as follows:

a. Perform the normal turn-off procedures as given in Chapter 3 of this manual.

b. Remove the right side panel of the 10-kw power amplifier cabinet.

WARNING

The 10-kw power amplifier has dangerous voltages that may prove fatal if contacted. Make sure that the 10-kw power amplifier is turned off, and that all high voltage points are discharged with the grounding rod before working in cabinet interior.

c. Adjust the output frequency of the uhf signal generator to the operating frequency of the 10-kw power amplifier.

d. Connect the bolometer mount to the microwave power meter.

e. Connect the rf output of the uhf signal generator to bolometer mount.

f. Observe the forward attenuation value 6 stamped on directional coupler 3DC1 (fig. 2-16). If it is 37.5 db (most common value) adjust the uhf signal generator output level to 1.8 mw as read on the microwave power meter. If the forward attenuation value stamped is not 37.5 db, the output level of the uhf signal generator must be computed as follows:

$$\text{uhf signal generator output level (in watts)} = \frac{10}{\left(\text{antilog}\frac{\text{forward attenuation value}}{10}\right)}$$

g. Disconnect plug 3P8 (on cable 3W1) from the forward probe of directional coupler 3DC1 (fig. 2-16).

h. Operate the INPUT FORWARD - 1ST CAVITY LOAD switch to the INPUT FORWARD position.

Table 5-4. 10-kw Power Amplifier Fault Indicator Data Chart

Trouble Indication	Location	Analysis	Probable Trouble
COOLANT TEMP indicator lamp on	AC Control Panel 3A3	Section B of COOLANT OVERLOAD RESET switch A1S8 closes and section A opens the beam control circuit, interrupting the beam	a. Temperature of coolant too high, owing to improper operation of 10-kw heat exchanger b. Excessive klystron power dissipation
PANEL OUT indicator lamp on	AC Control Panel 3A3	If one of the plugs to alarm power supply 3A3A3, regulator control panel 3A3A1, field coils regulator control panel 3A3A2, or beam regulator control panel 3A3A4 is out, this lamp goes on	Plug connection loose
ALARM PS FAILURE indicator lamp on	AC Control Panel 3A3	No power is supplied to the alarm relays. Relay 3A3A3K1 deenergizes and closes 12 and 13, causing the indicator lamp to go on	Failure of alarm panel 3A3A3
FIL UNREG and FIL REG LIMIT indicator lamps on	AC Control Panel 3A3	Relay 3A3K6 opens, and unregulated power is now applied	Failure of regulator assembly 3A5A1 or transformer 3A5T4, or lack of external 120-volt input (if SINGLE PHASE POWER ON indicator lamp DS2 goes off)
FIL REG LIMIT indicator lamp on	AC Control Panel 3A3	Same as FIL UNREG and FIL REG LIMIT indicator lamps	a. Failure of 120 volt regulator control 3A3A1 b. Failure of regulator assembly 3A5A1 or transformer 3A5T4, or excessive variation of unregulated input voltage
BEAM REG PRI OL or BEAM PRI OVERLOAD indicator lamp on	AC Control Panel 3A3	BEAM CONTROL VOLTAGE circuit breaker 3A2CB3 and BEAM AC OVERLOAD circuit breaker 3A2CB4 are open, interrupting the beam	Failure in beam power supply circuit
BEAM VOLTS LIMIT HIGH or BEAM VOLTS LIMIT LOW indicator on	AC Control Panel 3A3	The beam regulator is at its upper or lower limits, causing these lamps to go on	Failure in beam power supply or beam regulator control panel 3A3A4, or excessive variations of 3-phase input
RECYCLE indicator lamp on	AC Control Panel 3A3	A momentary rf or dc overload causes this lamp to go on	No trouble present if BEAM ON and INTERLOCKS lamps remain on. If BEAM ON and/or INTERLOCKS CLOSED indicator lamps go off, other indicator lamps identify trouble

Table 5-4. 10-kw Power Amplifier Fault Indicator Data Chart (cont)

Trouble Indication	Location	Analysis	Probable Trouble
BODY OVERLOAD indicator lamp on	AC Control Panel 3A3	The beam control circuit is interrupted, shutting off the beam	Incorrect prefocus or focus coil current, bias, or beam voltage
PREFOCUS COIL PWR indicator lamp on	AC Control Panel 3A3	PREFOCUS COIL PWR circuit breaker 3A3CB10 is open, resulting in an open beam interlock circuit, which prevents operation of the beam power supply	Failure in rectifier bridge 3A7CR1 or autotransformer 3A1T1 and associated circuits
ALARM POWER indicator lamp on	AC Control Panel 3A3	ALARM POWER circuit breaker 3A3CB11 is open, interrupting power to the relays and indicators	Failure of power supply transformer 3A3A3T1 or rectifier bridge 3A3A3CR1 through CR4 and associated circuits
FIL POWER indicator lamp on	AC Control Panel 3A3	FIL POWER circuit breaker 3A3CB9 is open, interrupting power to the klystron filaments and the beam control circuit	Failure of autotransformer 3A3T1, filament cam switch 3A3S1, or associated circuits
FIELD COILS POWER indicator lamp on	AC Control Panel 3A3	FIELD COILS POWER circuit breaker 3A3CB8 is open, interrupting power to the field coils. A set of contacts in the beam control circuit opens, interrupting the beam	Failure of relay 3A3K20, autotransformer 3A6T1, rectifier bridge 3A7CR2, or associated circuits
PUMP POWER indicator lamp on	AC Control Panel 3A3	PUMP POWER circuit breaker 3A3CB7 is open	Failure of pump motor, or relay 3A3K4 or associated circuits
BEAM OVERLOAD and/or BEAM POWER	AC Control Panel 3A3 and/or Distribution Panel 3A2	In the event of high beam current, beam current overload relay 3K1 is energized. Relay 3K1 opens set of contacts in the beam control circuit, interrupting the beam voltage	Failure or overload in beam power supply
GETTER POWER indicator lamp on	AC Control Panel 3A3	GETTER POWER circuit breaker 3A3CB5 is open	Failure of transformer 3A1T2 or associated circuits
KLYSTRON AIR COOLING PWR indicator lamp on	AC Control Panel 3A3	KLYSTRON AIR COOLING PWR circuit breaker 3A3CB3 is open. Cavity load fan 3A1B3, circulating fan 3A1B2, and blower 3A1B1 are off. Beam voltage and filament power are removed. CARRIAGE COOLING ON indicator lamp 3DS6 is off	Failure of cavity load fan 3A1B3, circulating fan 3A1B2, or blower 3A1B1

Table 5-4. 10-kw Power Amplifier Fault Indicator Data Chart (cont)

Trouble Indication	Location	Analysis	Probable Trouble
CABINET AIR COOLING PWR indicator lamp on	AC Control Panel 3A3	CABINET AIR COOLING PWR circuit breaker 3A3CB2 is open. Circulating fan 3B1 is off. Beam voltage and filament power are removed. CIRCULATION FAN ON indicator lamp 3DS5 is off	Failure of circulating fan 3B1 or intake fans 3A2B1 and 3A2B2
CABINET TEMP indicator lamp on	AC Control Panel 3A3	Beam control voltage is removed	a. Failure of blowers or thermostatic controls b. Excessive klystron power dissipation
SHUT DOWN indicator lamp on	AC Control Panel 3A3	SHUT DOWN circuit breaker 3A3 is open. The 10-kw power amplifier is shut down	Failure of any control circuit associated with SHUT DOWN circuit breaker 3A3CB1
LOW FWD POWER indicator lamp on	Meter Panel 3A4	A possible arc-over in third cavity tuning circuit or improper voltages may cause poor amplification and poor focusing	Low power input from exciter, or impedance mismatching on input transmission line
HIGH VSWR and/or VERY HIGH VSWR indicator lamps on	Meter Panel 3A4	OUTPUT BACK meter-relay will be reset to an extended range. When it reaches the set limit for very high vswr condition, VERY HIGH VSWR indicator lamp goes on and the beam control circuit is interrupted shutting off the beam	a. Mismatching in rf output transmission line b. Arc detector activated by presence of an arc in output cavity

i. Disconnect the uhf signal generator from the bolometer mount and connect the uhf signal generator to plug 3P8.

j. Adjust the INPUT FORWARD CAL control until the INPUT FORWARD - 1ST CAVITY LOAD meter indicates 10 watts.

k. Disconnect the uhf signal generator from plug 3P8 and reconnect plug 3P8 to directional coupler 3DC1.

l. Disconnect plug 3P10 (on cable 3W3) from the meter probe of directional coupler 3DC2 (fig. 2-19) and connect the uhf signal generator to plug 3P10.

m. Operate the INPUT FORWARD - 1ST CAVITY LOAD switch to the 1ST CAVITY LOAD position.

n. Adjust the 1ST CAVITY LOAD CAL control until the INPUT FORWARD - 1ST CAVITY LOAD meter indicates 10 watts.

o. Disconnect the uhf signal generator from plug 3P10 and reconnect plug 3P10 to directional coupler 3DC2.

5-23. CALIBRATION OF INPUT BACK METER. To calibrate the INPUT BACK meter continue as follows:

a. Connect the rf output of the uhf signal generator to the bolometer mount.

b. Observe the back attenuation value stamped on directional coupler 3DC1; if it is 33 db (most common value), adjust the signal generator output level to 0.25 mw as indicated on the microwave power meter. If the back attenuation value stamped is not 33 db, the output level of the uhf signal generator must be computed as follows:

$$\text{uhf signal generator output level (in watts)} = \frac{0.5}{\text{antilog}\frac{\text{back attenuation value}}{10}}$$

c. Disconnect plug 3P12 (on cable 3W5) from the back probe of directional coupler 3DC1 (fig. 2-8).

d. Operate the TUNE - FS 2 WATTS switch to FS 2 WATTS.

e. Disconnect the uhf signal generator from the bolometer mount and connect the uhf signal generator to plug 3P12.

f. Adjust the INPUT BACK CAL control of the INPUT BACK meter until the meter indicates 0.5 watt. Operate the TUNE - FS 2 WATTS switch to TUNE.

g. Disconnect the uhf signal generator from plug 3P12 and reconnect plug 3P12 to directional coupler 3DC1.

5-24. CALIBRATION OF OUTPUT FORWARD METER-RELAY. To calibrate the OUTPUT FORWARD meter-relay continue as follows:

a. Connect the rf output of the uhf signal generator to the bolometer mount.

b. Observe the forward attenuation value stamped on directional coupler 3DC5 (fig. 2-16); if it is 65 db (most common value), adjust the signal generator output level to 3.15 mw as indicated on the micreowave power meter. If the forward attenuation value stamped is not 65 db, the output level of the uhf signal generator must be computed as follows:

$$\text{uhf signal generator output level (in watts)} = \frac{0.5}{\text{antilog}\frac{\text{forward attenuation value}}{10}}$$

c. Disconnect plug 3P20 (on input cable 3W1) from the IN probe of directional coupler 3DC5.

d. Disconnect the uhf signal generator from the bolometer mount and connect the uhf signal generator to plug 3P20.

e. Adjust the OUTPUT FORWARD CAL control of the OUTPUT FORWARD meter-relay until the meter indicates 10 kw.

f. Disconnect the uhf signal generator from plug 3P20 and reconnect plug 3P20 to directional coupler 3DC5.

5-25. CALIBRATION OF OUTPUT BACK METER-RELAY. To calibrate the OUTPUT BACK meter-relay continue as follows:

a. Connect the rf output of the uhf signal generator to the bolometer mount.

b. Observe the back attenuation value stamped on directional coupler 3DC5; if it is 55 db (most common value), adjust the uhf signal generator output level to 1.6 mw as indicated on the microwave power meter. If the back attenuation value stamped is not 55 db, the output level of the uhf signal generator must be computed as follows:

$$\text{uhf signal generator output level (in watts)} = \frac{500}{\text{antilog}\frac{\text{back attenuation value}}{10}}$$

c. Disconnect plug 3P14 (on cable 3W15) from the OUT probe of directional coupler 3DS5.

d. Disconnect the uhf signal generator from the bolometer mount and connect the uhf signal generator to plug 3P14.

e. Adjust the CAL HIGH VSWR control of the OUTPUT BACK meter-relay until the meter indicates 500 watts.

WARNING

Voltages are present which could cause death on contact. Before continuing, discharge all exposed high voltage surfaces with the grounding rod.

f. Operate the MAIN POWER (on upper portion of the distribution panel) and SHUT DOWN, FIL POWER, and ALARM POWER circuit breakers on the ac control panel to the ON position.

g. Adjust the red pointer of the OUTPUT BACK meter-relay so that it makes contact with the black pointer, the HIGH VSWR indicator (on the meter panel) should light.

h. Adjust the CAL VERY HIGH VSWR control until the OUTPUT BACK meter indicates 250 watts.

i. Reset the OUTPUT BACK meter by momentarily operating the RESET-NORMAL-AUTOMATIC switch on the ac control panel to the RESET position.

j. Operate the ALARM POWER, FIL POWER, SHUT DOWN, and MAIN POWER circuit breakers to the OFF position.

WARNING

Voltages may be present which could cause death on contact. Before continuing, discharge all exposed voltage surfaces with the grounding rod.

k. Disconnect the uhf signal generator from plug 3P14 and reconnect plug 3P14 to directional coupler 3DC5.

5-26. CALIBRATION OF 2ND CAVITY LOAD METER. To calibrate the 2ND CAVITY LOAD meter continue as follows:

a. Connect the rf output of the uhf signal generator to the bolometer mount.

b. Observe the attenuation value stamped on directional coupler 3DC3 (fig. 2-19); if it is 45 db (most common value), adjust the uhf signal generator output level to 3.15 mw as indicated on the microwave power meter. If the attenuation value stamped is not 45 db, the output level of the uhf signal generator must be computed as follows:

$$\text{uhf signal generator output level (in watts)} = \frac{100}{\text{antilog}\frac{\text{attenuation value}}{10}}$$

c. Disconnect plug 3P16 (on cable 3W9) from the meter probe of directional coupler 3DC3.

d. Disconnect the uhf signal generator from the bolometer mount and connect the uhf signal generator to plug 3P16.

e. Adjust the 2ND CAVITY LOAD CAL control of the 2ND CAVITY LOAD meter until the meter indicates 100 watts.

f. Disconnect the uhf signal generator from plug 3P16 and reconnect plug 3P16 to directional coupler 3DC3.

5-27. CALIBRATION OF 3RD CAVITY LOAD METER. To calibrate the 3RD CAVITY LOAD meter continue as follows:

a. Connect the rf output of the uhf signal generator to the bolometer mount.

b. Observe the attenuation value stamped on directional coupler 3DC4 (fig. 2-19); if it is 55 db (most common value), adjust the signal generator output level to 3.15 mw as indicated on the microwave power meter. If the attenuation value stamped is not 55 db, the output level of the signal generator must be computed as follows:

$$\text{uhf signal generator output level (in watts)} = \frac{1000}{\text{antilog}\frac{\text{attenuation value}}{10}}$$

c. Disconnect plug 3P18 (on cable 3W11) from the meter probe of directional coupler 3DC4, and connect the uhf signal generator to plug P18.

d. Adjust the 3RD CAVITY LOAD CAL control of the 3RD CAVITY LOAD meter until the meter indicates 1 kw.

e. Disconnect the uhf signal generator from plug 3P18 and reconnect plug 3P18 to directional coupler 3DC4.

f. Replace the right side panel of the 10-kw power amplifier.

5-28. KLYSTRON FIL VOLTS METER ALIGNMENT.

5-29. To align the KLYSTRON FIL VOLTS meter proceed as follows:

a. Perform the normal turn-off procedures as given in Chapter 3 of this manual (if not previously accomplished).

b. Remove input from associated exciter.

c. Swing out the ac control panel remove the rear cover assembly (fig. 5-3), and manually defeat interlock switch.

d. Raise the meter panel (fig. 2-22) until the panel arms are extended to the locking position. Manually defeat the interlock switch.

WARNING

Dangerous voltages, which may cause death or serious injury if contacted, may be present. Before proceeding, discharge all exposed high voltage points with the grounding rod.

e. Operate the MAIN POWER circuit breaker to ON.

f. Operate the SHUT DOWN circuit breaker to ON.

NOTE

Ensure the associated heat exchanger is set for remote operation.

g. Operate the HEAT EXCHANGER switch on the ac control panel to ON. The KLYSTRON COOLANT FLOW gauge on the klystron carriage should indicate a minimum flow of 18 gallons per minute.

h. Operate the CABINET AIR COOLING PWR circuit breaker on the ac control panel to ON.

i. Operate the KLYSTRON AIR COOLING PWR circuit breaker on the ac control panel to ON.

j. Operate the FIL POWER and FIL PWR circuit breakers on the ac control panel to ON.

k. Connect the multimeter (ac volts) to the klystron filament input connections (fig. 2-22) on terminal board 3TB10.

l. Adjust KLYSTRON FIL VOLTS calibration control 3R1 (fig. 5-3) until the voltage indicated on the KLYSTRON FIL VOLTS meter is the same as that indicated on the multimeter.

m. Remove the multimeter. Lower the meter panel, replace rear cover assembly on the ac control panel, and close the ac control panel.

n. Operate the SHUT DOWN, CABINET AIR COOLING PWR, KLYSTRON AIR COOLING PWR, FIL POWER, and FIL PWR circuit breakers to OFF.

o. Set the HEAT EXCHANGER switch to OFF.

p. After the 10-kw power amplifier fans stop turning, operate the MAIN POWER circuit breaker to OFF.

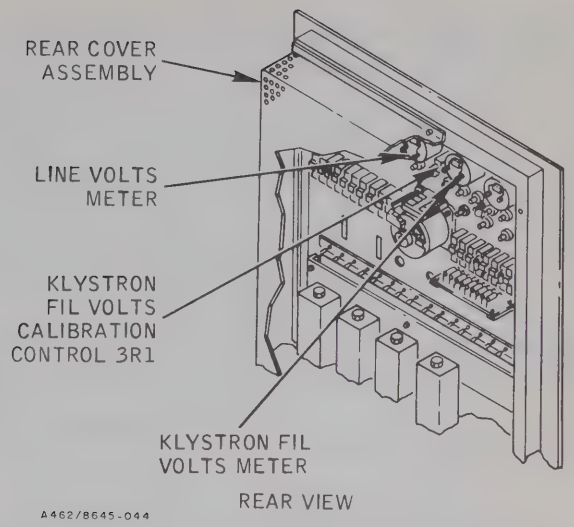

Figure 5-3. AC Control Panel Chassis

5-30. 120-VOLT REGULATOR CONTROL PANEL ALIGNMENT.

5-31. The following procedure may be performed with the 10-kw power amplifier in normal operation (however, if the 10-kw power amplifier is turned off, the following circuit breakers must be set to ON: MAIN POWER, SHUT DOWN, REGULATED POWER, FIL POWER, and 120-volt regulator control panel POWER):

a. Operate the LINE VOLTS switch on the ac control panel to the REG/UNREG position.

b. Adjust the CALIBRATE control on the 120-volt regulator control panel until the LINE VOLTS meter on the ac control panel indicates 120 volts.

c. Adjust the SENSITIVITY control on the 120-volt regulator control panel for a maximum deviation of 1.2 volts above or below the 120 volts indicated on the LINE VOLTS meter in step b.

d. Operate the LINE VOLTS switch on the ac control panel to the OFF position.

CAUTION

If repairs have been made to the klystron carriage or if you are performing postinstallation alignment and adjustment proceed to paragraph 5-36 before performing the following alignment procedure.

5-32. FIELD COILS REGULATOR CONTROL PANEL ALIGNMENT.

5-33. To align the field coils regulator control panel ensure that normal excitation is applied from the associated exciter and proceed as follows:

a. If the 10-kw power amplifier is not in normal operation turn it on in accordance with the instructions given in Chapter 3 of this manual and allow the 10-kw power amplifier a warmup period of at least one-half hour.

b. Record the beam voltage indicated on the BEAM VOLTS meter.

c. Adjust the BEAM VOLTAGE ADJUST control until the BEAM VOLTS meter on the meter panel reads 10 kv.

d. Adjust the CALIBRATE control on the field coils regulator control panel for minimum indication of the BODY CURRENT meter on the meter panel.

e. Adjust the SENSITIVITY control until there is a maximum 1.5 ma deviation away from the minimum BODY CURRENT meter reading obtained in step c.

f. Return the beam voltage to the value recorded in step b.

5-34. BEAM REGULATOR CONTROL PANEL ALIGNMENT.

5-35. To align the beam regulator control panel, ensure that normal excitation is applied from the associated exciter and proceed as follows:

a. If the 10-kw power amplifier is not in normal operation turn it on in accordance with the instructions given in Chapter 3 of this manual.

b. Record the BEAM VOLTS and the OUTPUT FORWARD meter indications.

c. Detune the 3rd cavity by rotating the 3RD CAVITY TUNING control four complete turns in a clockwise direction.

d. Turn the BEAM VOLTAGE ADJUST control on the klystron carriage slowly in a counterclockwise direction, alternately adjusting the PREFOCUS COIL CURRENT ADJUST control, to maintain a minimum body current indication on the BODY CURRENT meter located on the meter panel. Turn the BEAM VOLTAGE ADJUST fully counterclockwise.

e. Adjust the CALIBRATE control on the beam regulator control panel until the BEAM VOLTS meter on the meter panel indicates 6 kv.

f. Adjust the SENSITIVITY control on the beam regulator control panel for maximum 60-volt deviation above or below the 6 kv indicated on the BEAM VOLTS meter in step d.

g. Turn the BEAM VOLTAGE ADJUST control on the klystron carriage in a clockwise direction, alternately adjusting the PREFOCUS COIL CURRENT ADJUST control to maintain a minimum indication on the BODY CURRENT meter, until the BEAM VOLTS meter indicates the value recorded in step b.

h. Retune the 3rd cavity by rotating the 3RD CAVITY TUNING control in a counterclockwise direction until the OUTPUT FORWARD meter indicates the value recorded in step b.

5-36. ADJUSTMENT AND TUNING OF THE 10-KW POWER AMPLIFIER.

5-37. The 10-kw power amplifier must be adjusted and tuned after initial installation, frequency change, repair, equipment shutdown in excess of one hour, or whenever adjustment or tuning control settings have been changed. Before proceeding, all rf meters should be calibrated as described in paragraphs 5-20 through 5-27; the KLYSTRON FIL VOLTS meter should be aligned as described in paragraph 5-28; and the 120-volt regulator control panel should be aligned as described in paragraph 5-30. If the 10-kw power amplifier is in operation and is to be retuned, proceed with step u; however, if the 10-kw power amplifier is deenergized perform the following steps:

a. Ensure that all the 10-kw power amplifier circuit breakers are set to OFF and the OUTPUT COUPLING ADJUST control is turned fully in the INCREASE direction.

b. Turn the OUTPUT CAVITY TUNING control to its minimum DECREASE FREQUENCY setting and turn the 3RD CAVITY TUNING control to its maximum INCREASE FREQUENCY setting.

c. Set the red pointer of each meter-relay as follows:

(1) BODY CURRENT meter-relay, fully upscale.

(2) OUTPUT FORWARD meter-relay, fully downscale.

(3) OUTPUT BACK meter-relay, fully upscale.

d. Turn the INPUT CAVITY TUNING control to 500, as read on the associated counter, and rotate the INPUT COUPLING ADJUST control to its midpoint position.

e. Turn the BIAS VOLTAGE ADJUST control on the distribution panel fully clockwise (maximum bias voltage position).

f. Turn the KLYSTRON FIL VOLTS ADJUST control on the ac control panel to 0.

g. Turn the LINE VOLTS switch to AB.

h. Turn the PREFOCUS COIL CURRENT ADJUST control on the klystron carriage to 0.

i. Turn the BEAM VOLTAGE ADJUST control to 6.

j. Set the TD CHEATER switch on the ac control panel to the center position.

k. Set the RESET-NORMAL-AUTOMATIC switch to NORMAL.

l. Set the MAIN POWER circuit breaker to ON.

m. Check that the LINE VOLTS meter reads from 197.6 to 218.4 volts. Turn the LINE VOLTS switch to BC, then AC, and ensure that the LINE VOLTS meter reads from 197.6 to 218.4 volts for each setting.

n. Set the KLYSTRON AIR COOLING PWR circuit breaker to ON.

o. Set the CABINET AIR COOLING PWR circuit breaker to ON.

p. Set the SHUT DOWN circuit breaker to ON.

q. Set the HEAT EXCHANGER switch on the ac control panel to ON. Check that the KLYSTRON COOLANT FLOW gauge on the klystron carriage indicates at least 18 gallons per minute.

r. Set the POWER circuit breakers on the 120-volt regulator control panel and field coils regulator control panel to ON.

s. Set the GETTER POWER, REGULATED POWER, FIELD COILS POWER, FIL POWER, PREFOCUS COIL PWR, and ALARM POWER circuit breakers on the ac control panel to ON.

t. Turn the LINE VOLTS switch to REG/UNREG and ensure that the LINE VOLTS meter reads from 118.8 to 121.2 volts. Set the LINE VOLTS switch to OFF.

u. If the 10-kw power amplifier has been in service, reduce the beam voltage to 6 kv, depress the BEAM VOLTAGE OFF pushbutton, and set the BEAM CONTROL VOLTAGE circuit breaker on the distribution panel and the POWER circuit breaker on the beam regulator control panel to OFF.

v. Ensure that the BEAM REGULATOR POSITION indicator on the distribution panel is set at 0.

w. Adjust the PREFOCUS COIL CURRENT ADJUST control on the klystron carriage until the PREFOCUS COIL CURRENT meter on the meter panel indicates 0.5 ampere.

x. Apply a 5-watt rf input signal from an associated exciter to the 10-kw power amplifier. The INPUT FORWARD-1ST CAVITY LOAD meter should indicate 5 watts.

y. Operate the LOCK-UNLOCK lever on the line stretcher to UNLOCK, and operate the LINE STRETCHER ADJUST control for a minimum indication on the INPUT BACK meter coincident with a maximum indication on the INPUT FORWARD-1ST CAVITY LOAD meter.

NOTE

When adjusting the KLYSTRON FIL VOLTS ADJUST control, the FILAMENT CKT ON indicator lamp should light when the KLYSTRON FIL VOLTS meter indicates approximately 3.5 volts. Further, the BEAM T.D. OVER indicator lamp should light 5 minutes after the FILAMENT CKT ON indicator lamp lights.

z. Adjust the KLYSTRON FIL VOLTS ADJUST control for a reading of 7.5 volts on the KLYSTRON FIL VOLTS meter.

CAUTION

The klystron filament voltage should not be applied longer than one-half hour without applying beam voltage.

aa. On the klystron carriage, set the INPUT FORWARD - 1ST CAVITY LOAD switch

to INPUT FORWARD and the TUNE - FS 2 WATTS switch to TUNE.

ab. Adjust the 1ST CAVITY TUNING control for maximum indication on the INPUT FORWARD - 1ST CAVITY LOAD meter. (If necessary, vary the INPUT CAVITY TUNING control to obtain a noticeable indication.)

ac. Set the TUNE - FS 2 WATTS switch to FS 2 WATTS and readjust the line stretcher for minimum indication on the INPUT BACK meter. Operate the LOCK-UNLOCK lever to LOCK.

ad. With the TUNE - FS 2 WATTS switch set to FS 2 WATTS, adjust INPUT CAVITY TUNING and the INPUT COUPLING ADJUST controls for minimum indication on the INPUT BACK meter. (If necessary, readjust 1ST CAVITY TUNING control to further minimize the INPUT BACK meter indication.)

ae. Increase the exciter rf input signal to the 10-kw power amplifier to 10 watts as indicated by the INPUT FORWARD-1ST CAVITY LOAD meter.

af. With the INPUT FORWARD - 1ST CAVITY LOAD switch set to 1ST CAVITY LOAD, repeat steps ab and ad.

ag. Set the INPUT FORWARD - 1ST CAVITY LOAD switch to INPUT FORWARD.

ah. Set the BEAM POWER and BEAM AC OVERLOAD circuit breakers to ON.

CAUTION

Before depressing BEAM VOLTAGE ON pushbutton, ensure that the 3RD CAVITY TUNING control is set to its maximum INCREASE FREQUENCY setting.

ai. Depress the BEAM VOLTAGE ON pushbutton on the klystron carriage.

aj. Slowly increase the beam voltage in 1-kv steps, by setting the BEAM VOLTAGE RAISE-LOWER switch to RAISE, until 10 kv is indicated on the BEAM VOLTS meter on the meter panel. For each 1-kv increase in beam voltage, adjust the PREFOCUS COIL CURRENT ADJUST and PREFOCUS COIL POSITIONING controls on the klystron carriage for minimum (well below 100 ma) indication on the BODY CURRENT meter-relay.

ak. Slowly increase the beam voltage by setting the BEAM VOLTAGE RAISE-LOWER switch to RAISE until the BEAM VOLTS meter indicates 15 kv. Adjust the PREFOCUS COIL CURRENT ADJUST and PREFOCUS COIL POSITIONING controls for minimum indication on the BODY CURRENT meter-relay.

al. Adjust the 2ND CAVITY TUNING control on the klystron carriage for maximum indication on the 2ND CAVITY LOAD meter.

am. Adjust the 3RD CAVITY TUNING control for maximum indication on the OUTPUT FORWARD meter-relay and the 3RD CAVITY TUNING control for minimum indication on the BODY CURRENT meter-relay.

CAUTION

The indication on the 3RD CAVITY LOAD meter must not exceed 500 watts or damage to the load will result.

an. Adjust the OUTPUT CAVITY TUNING and OUTPUT COUPLING ADJUST controls simultaneously, until the OUTPUT FORWARD meter-relay indicates 8.5 kw.

ao. Rotate the 3RD CAVITY TUNING control four complete turns in the INCREASE FREQUENCY direction and adjust the OUTPUT CAVITY TUNING and OUTPUT COUPLING ADJUST controls for maximum OUTPUT FORWARD meter-relay indication. If the OUTPUT FORWARD meter-relay exceeds 8.5 kw, repeat step an, readjusting controls in the DECREASE FREQUENCY direction.

ap. Rotate the 3RD CAVITY TUNING control approximately five turns in the INCREASE FREQUENCY direction and rotate the OUTPUT COUPLING ADJUST control one turn in the DECREASE FREQUENCY direction.

aq. Slowly increase the beam voltage by setting the BEAM VOLTAGE RAISE-LOWER switch to RAISE until the BEAM VOLTS meter indicates 17 kv. Adjust the PREFOCUS COIL CURRENT ADJUST control as required to keep body current to minimum as indicated on the BODY CURRENT meter-relay.

ar. Adjust the BIAS VOLTAGE ADJUST control on the distribution panel until the BEAM CURRENT meter on the meter panel indicates 1.9 amperes. After this adjustment is made, the BIAS VOLTAGE meter should indicate from 300 to 320 volts.

NOTE

Adjustment of the PREFOCUS COIL CURRENT ADJUST control may require recalibration of the field coils regulator panel (para 5-32) to maintain minimum body current.

as. Adjust the PREFOCUS COIL CURRENT ADJUST control on the klystron carriage for a minimum indication on the BODY CURRENT meter-relay.

at. Adjust the 2ND CAVITY TUNING control for a maximum indication on the 2ND CAVITY LOAD meter.

au. Adjust the 3RD CAVITY TUNING control until the OUTPUT FORWARD meter-relay indicates 10.5 kw.

av. Turn the OUTPUT CAVITY TUNING control in the INCREASE FREQUENCY direction until OUTPUT FORWARD meter indicates 10 kw.

CAUTION

After completion of step aw, the PREFOCUS COIL CURRENT meter indication must not exceed the value specified in the manufacturer's data card by more than 20 percent. The manufacturer's test data card should be attached to the klystron carriage door.

aw. Adjust the PREFOCUS COIL CURRENT ADJUST control for a maximum indication on the OUTPUT FORWARD meter-relay. Check that the BODY CURRENT meter-relay indicates well below 100 ma.

ax. Set the BEAM VOLTAGE ADJUST control on the klystron carriage to 15. Set the BEAM CONTROL VOLTAGE circuit breaker on the distribution panel and the POWER circuit breaker on the beam regulator control panel to ON. Adjust the BEAM VOLTAGE ADJUST control until the BEAM VOLTS meter indicates 17 kv.

ay. Adjust the 3RD CAVITY TUNING control in the INCREASE FREQUENCY direction until the OUTPUT FORWARD meter indicates 10 kw.

az. If the 10-kw power amplifier is to be operated at a power output lower than 10 kw, adjust the 3RD CAVITY TUNING control in a DECREASE FREQUENCY direction to the desired output level, concurrently performing step as.

ba. Set the red pointers of each meter-relay as follows:

(1) BODY CURRENT meter-relay, at 100 ma.

(2) OUTPUT FORWARD meter-relay, at 1 kw below the output power.

(3) OUTPUT BACK meter-relay, at 100 w.

bb. If you are performing postinstallation alignment and adjustment, align the field coils regulator control panel in accordance with paragraph 5-32, align the beam regulator control panel in accordance with paragraph 5-34, and then repeat step d, and steps v through ba.

5-38. MAINTENANCE OF BEAM POWER SUPPLY TRANSFORMER.

5-39. With the exception of the checking and replacement of the desiccant, maintenance of the beam power transformer is not normally performed at organizational/field level. The procedure for checking and replacing the desiccant is given in the following paragraphs. For further maintenance of the beam power transformer refer to paragraphs 5-49 through 5-88.

5-40. CHECKING THE CONDITION OF THE DESICCANT.

5-41. When the normally blue pellets of the silica-gel desiccant begin to turn pink, it is a sign that the desiccant is losing its moisture absorption properties and must be replaced. To check the condition of the silica-gel, open the ac control panel and observe the color through the window on the moisture filtering breather tank (fig. 5-4).

5-42. REPLACEMENT OF THE DESICCANT.

a. Perform the normal turn-off procedure as given in Chapter 3 of this manual.

b. Release the two fasteners securing the hinged ac control panel and swing the ac control panel to the right.

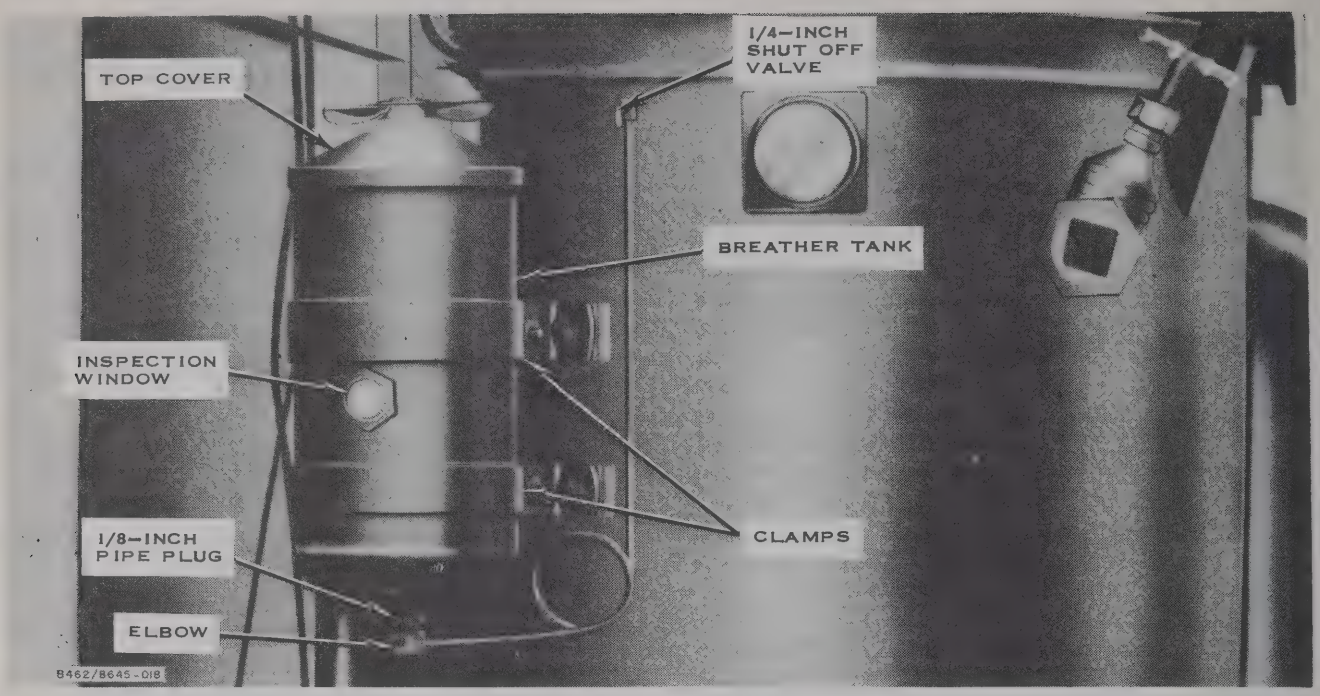

Figure 5-4. Breather Tank

WARNING

Dangerous voltages, which may cause death or serious injury if contacted, may be present. Before proceeding, discharge all exposed high voltage points with the grounding rod.

c. Close the 1/4-inch shutoff valve near the upper front of the beam power supply (fig. 5-5).

d. Disconnect the 1/4-inch tubing elbow from the bottom of the breather tank.

e. Remove the top cover from the breather tank and discard the old silica-gel.

f. Dry out the breather tank with the cleaning cloth and refill the tank with the silica-gel.

g. Install the top cover on the breather tank and reconnect tubing and clamps.

h. Open the 1/4-inch shutoff valve.

i. Close and secure the ac control panel by connecting the two fasteners.

5-43. KLYSTRON TUBE GAS TEST AND REMOVAL.

5-44. KLYSTRON TUBE GAS TEST.

5-45. The purpose of this test is to check that the klystron tube's operation is not adversely affected by the quantity of internal gas.

5-46. To test for gas in the klystron tube proceed as follows:

a. Record the indication on the BEAM VOLTS meter on the meter panel.

b. Reduce the beam voltage to approximately 6 V by rotating the BEAM VOLTAGE ADJUST control fully counterclockwise. Depress the BEAM VOLTAGE OFF pushbutton.

WARNING

The equipment has dangerous voltages that may prove fatal if contacted. Make sure that all high-voltage points are discharged with the grounding rod.

c. Raise the meter panel (fig. 2-22) until the panel arms are extended to the locking position. Manually defeat the interlock switch.

d. Connect the multimeter across resistor 3R22 (fig. 2-7) with the positive lead to the terminal of resistor 3R22 connected to the modulating anode clamp connection.

e. Depress the BEAM VOLTAGE ON pushbutton.

f. Slowly rotate the BEAM VOLTAGE ADJUST control clockwise to position 11, while observing the multimeter. If the multimeter exceeds 100 volts; the klystron is gassy; proceed with paragraph 5-47. If the multimeter indication does not exceed 100 volts, proceed with step g.

g. Operate the BEAM VOLTAGE ADJUST control fully counterclockwise and depress the BEAM VOLTAGE OFF pushbutton.

WARNING

The equipment has dangerous voltages that may prove fatal if contacted. Make sure that all high-voltage points are discharged with the grounding rod.

h. Remove the multimeter and close the meter panel.

i. Depress the BEAM VOLTAGE ON pushbutton and rotate the BEAM VOLTAGE ADJUST control until the voltage recorded in step a is indicated on the BEAM VOLTS meter.

5-47. KLYSTRON TUBE GAS REMOVAL.

5-48. To remove the gas from the klystron tube proceed as follows:

a. Reduce the beam voltage to approximately 6-kv by rotating the BEAM VOLTAGE ADJUST control fully counterclockwise (if not previously reduced) and allow the 10-kw power amplifier to operate with this beam voltage for approximately one-half hour. During this half-hour operation, the GETTER BOOST switch on the ac control panel should be frequently depressed for about 10 seconds each time.

b. Repeat the test given in paragraph 5-44. If the multimeter still indicates 100 volts or more the klystron tube is faulty and must be replaced in accordance with the instructions given in paragraph 5-57.

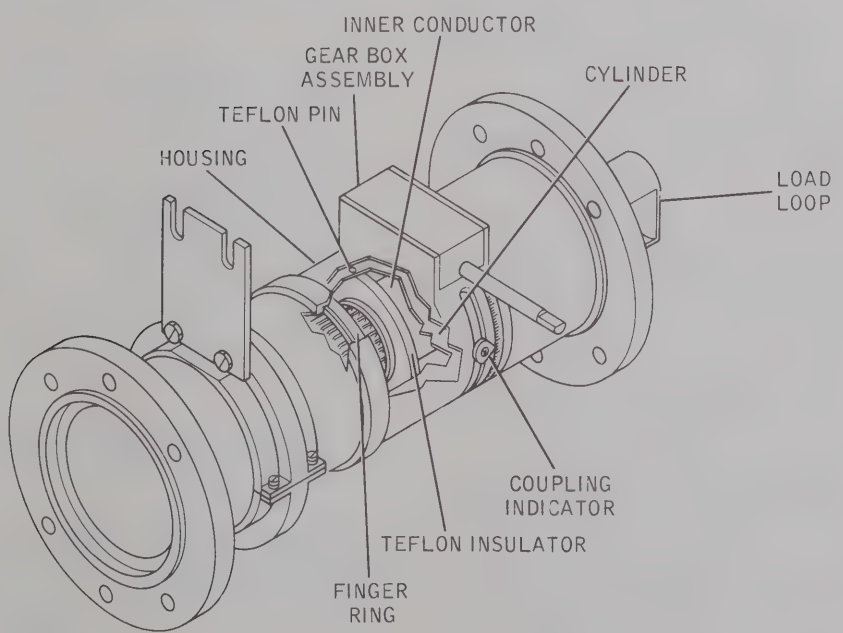

Figure 5-5. Output Load Coupler

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SECTION III
SPECIAL MAINTENANCE

5-49. GENERAL.

5-50. This section contains data necessary for special maintenance of the 10-kw power amplifier not normally accomplished at organizational/field level. These maintenance procedures can only be performed when the equipment is not in operation. In performing maintenance according to these instructions refer to TM 11-5820-757-25P

5-51. TOOLS AND TEST EQUIPMENT.

5-52. The tools and test equipment required to perform the maintenance procedures presented in this section are listed in table 1-4.

5-53. REMOVAL AND REPLACEMENT OF UNITS.

5-54. All units, except the klystron carriage, the klystron tube, the output load coupler, the output load coupling loop, the beam power transformer and the beam power primary control, are replaced by removing their mounting hardware and wiring. When reassembling insure that all wiring is returned to its proper connection. Removal and replacement procedures for the above mentioned components are covered in paragraphs 5-55, 5-57, 5-59, 5-62, 5-65, and 5-68, respectively.

5-55. KLYSTRON CARRIAGE REMOVAL, DISASSEMBLY, REASSEMBLY, AND REPLACEMENT.

5-56. The klystron carriage is removed as described in paragraph 2-63, disassembled as described in paragraph 2-64, reassembled as described in paragraph 2-36 and replaced as described in paragraph 2-46.

5-57. KLYSTRON TUBE REPLACEMENT.

5-58. To replace the klystron tube the klystron carriage must be removed, disassembled, reassembled (with a new klystron tube), and replaced in accordance with the instructions given in paragraph 5-55.

5-59. OUTPUT LOAD COUPLER REMOVAL AND REPLACEMENT.

5-60. REMOVAL. To remove output load coupler 3W22 refer to figure 2-16 and proceed as follows:

a. Remove the klystron carriage as described in paragraph 2-63.

b. Disconnect rf cables 3W7 and 3W13 from output directional coupler 3DC5.

c. Remove the bolts that secure rf elbow 3W24 to output load coupler 3W22.

d. Loosen the screws that secure the rf output transmission line retainer.

e. Slide the entire transmission line assembly toward the front panel, separating the rf elbow from the output load coupler and keeping the transmission line vertical.

f. While an assistant supports the transmission line at the rf elbow, spread the rf output transmission line retainer and remove the transmission line from the carriage.

g. Remove the top half of the output load coupler cradle assembly.

h. Disconnect and remove the output load coupler drive shaft (fig. 2-14).

i. Remove the six nuts securing the output load coupler to output cavity 3Z4 (fig. 2-19).

j. While an assistant supports the output load coupler, loosen the two screws supporting the cradle and drop the cradle supporting assembly to the bottom of the magnetic frame.

k. Grasp the output load coupler through the front panel access opening, then apply an oscil-

lator motion and gently pull out the output load coupler from the output cavity.

5-61. REPLACEMENT. Output load coupler 3W22 is replaced by reversing the order of the procedure given in paragraph 5-60.

5-62. OUTPUT LOAD COUPLER LOAD LOOP REMOVAL AND REPLACEMENT.

5-63. REMOVAL. To remove the output load coupler load loop refer to figures 5-5 and 5-6 and proceed as follows:

a. Remove the output load coupler in accordance with the instructions given in paragraph 5-59.

b. Remove coupling indicator.

c. Separate the two halves of the output load coupler by using two strap wrenches on the housing. The housing has a right-hand thread,

d. Using the spanner wrench provided on top of the klystron carriage, remove the finger ring.

e. Remove four Allen-head screws securing the gear box assembly to the housing. Remove any spacers from under the gear box assembly and note their position.

f. Slide the cylinder and the load loop out of the housing through the threaded end of the housing. Remove the two cylinder bearings (teflon strips) from the cylinder.

g. Remove the teflon pins by carefully drilling into them with a no. 30 drill through the cylinder wall holes to a depth of three-eighths of an inch.

h. Using pliers, pull out the four brass pins from the end of the inner conductor.

i. Spread the teflon insulator and remove it from the inner conductor.

5-64. REPLACEMENT. The output load coupler load loop (figs. 5-5 and 5-6) is replaced as follows:

a. Place the teflon insulator over the inner conductor with coupling loop and insert the four brass pins.

b. Slide the inner conductor into the cylinder. Align the holes in the cylinder with the holes in the teflon insulator.

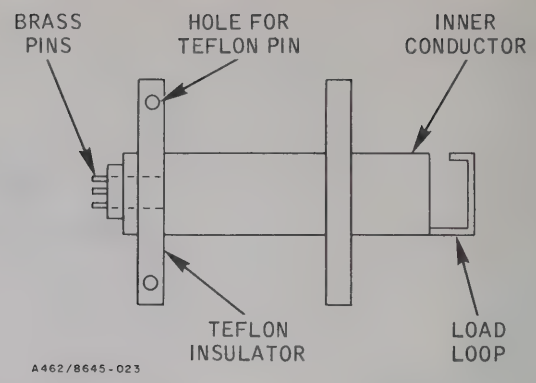


Figure 5-6. Inner Conductor, Coupling Loop and Teflon Insulator

c. Insert new teflon pins through the cylinder holes and the holes in the teflon disc. Using a sharp knife or razor blade, cut off the exposed ends of the pins so that the ends are flush with the outside of the cylinder wall.

d. Replace the teflon bearing strips on the cylinder and slide the cylinder into the housing. Align the coupling indicator hole in the cylinder with the slot in the housing.

e. Install the coupling indicator.

f. Install the gear box assembly using the spacers previously removed. Make sure the teeth on the cylinder wall are engaged with the worm gear before fully tightening the four Allen-head screws.

g. Install the finger ring and tighten with the spanner wrench.

h. Assemble the two sections of the housing. Do not use strap wrenches; finger tighten only.

i. Replace the output load coupler in accordance with the instructions given in paragraph 5-60.

5-65. BEAM POWER TRANSFORMER REMOVAL AND REPLACEMENT.

5-66. REMOVAL. To remove beam power supply transformer 3T4 proceed as follows:

a. Turn off the 10-kw power amplifier in accordance with the instructions given in Chapter 3.

WARNING

This equipment has dangerous voltages that may prove fatal if contacted. Make sure that all high-voltage points are discharged with the grounding rod.

b. Loosen two knurled knobs on the ac control panel and swing the panel completely open.

c. Perform the procedure given in paragraph 2-31 in reverse order.

5-67. REPLACEMENT. Beam power transformer 3T4 is replaced in accordance with the instructions given in paragraph 2-31.

5-68. BEAM POWER PRIMARY CONTROL REMOVAL AND REPLACEMENT.

5-69. REMOVAL. To remove the beam power primary control, 3A5, proceed as follows:

a. Turn off the 10-kw power amplifier in accordance with the instructions given in Chapter 3.

b. To gain access and to expose the beam power primary control, remove the klystron carriage in accordance with paragraph 2-63.

WARNING

Make sure that all high-voltage points within the cabinet are discharged with the grounding rod.

c. Disconnect all wires on the beam power primary control.

d. Loosen the setscrew in the dial pointer of the BEAM REGULATOR POSITION indicator on the distribution panel. Remove the dial pointer and withdraw the end of the flexible shaft from the back of the panel.

NOTE

Two men are needed to remove the beam power primary control because of its weight.

e. Remove the bolts at the base of the beam power primary control and lift out the entire assembly.

5-70. REPLACEMENT. Beam power primary control 3A5 is replaced as follows:

a. Perform the procedure given in paragraph 5-69 in reverse order.

b. Ensure that the position of the BEAM REGULATOR POSITION dial pointer on the front of the distribution panel corresponds to the proper position of the beam power primary control.

5-71. BEAM POWER SUPPLY TRANSFORMER MAINTENANCE.

5-72. CHECKING OF TRANSFORMER OIL DIELECTRIC STRENGTH.

5-73. GENERAL. The dielectric strength of the transformer oil must be tested every 6 months. The procedure for testing the dielectric strength of the transformer oil consists of taking a sample of oil from the beam power transformer and determining the voltage at which the dielectric properties of the oil breaks down.

5-74. SAMPLING OF TRANSFORMER OIL. Oil samples should be taken only when the beam power transformer has been in normal operation for at least 8 hours prior to the sampling. Refer to figure 3-6 and take an oil sample from the beam power transformer as follows:

a. Loosen two knurled knobs on the ac control panel and swing the panel completely open.

WARNING

This equipment has dangerous voltage that may prove fatal if contacted. Make sure that all high-voltage points are discharged with the grounding rod.

b. Draw off an equal amount of oil from the upper filter press valve and the oil drainage valve into an unused, large-mouthed, 16-ounce glass bottle, thoroughly cleaned with benzene.

NOTE

Draw off enough oil to ensure that the sample consists of oil contained in the tank near the top and bottom of the transformer, and not merely of oil stored in the valves.

c. Inspect the oil for air bubbles and water. If air bubbles are present, allow the sample to stand until it is clear. If water is present, investigate and determine the cause (break in seal, cracked bushing, or other cause).

5-75. TESTING OF TRANSFORMER OIL. To test the dielectric strength of the transformer oil in the beam power transformer, use a portable oil tester, G.E. 9T11Y 8454, or equivalent, and proceed as follows:

a. Clean the test cup of the portable oil tester thoroughly with benzene and rinse with a portion of the oil sample.

NOTE

The oil sample in the glass bottle must be thoroughly mixed before filling the test cup. This operation is important since impurities that may be present in the oil have a tendency to settle to the bottom and the test results may be misleading.

b. Fill the test cup with the sample oil to approximately 3/4 of an inch above the top of the electrodes.

c. Let the oil stand for approximately 1 minute to allow the air bubbles to escape. To expedite the removal of air bubbles, rock the cup of a few times.

d. Rotate the variac control fully counterclockwise and connect the leads of the oil tester transformer to the test cup electrodes.

WARNING

Potentials in excess of 26 kilovolts will be present at the test cup electrodes. Exercise care when performing the following tests.

e. Energize the portable oil tester and increase the voltage at a rate of about 3000 volts per second until breakdown occurs. Record the voltage at which breakdown occurred.

f. Deenergize the portable oil tester and disconnect the leads from the test cup.

g. Repeat steps a through e above, thoroughly cleaning the test cup before filling.

h. To determine the dielectric strength of the oil, take the average breakdown voltage for the two tests.

i. If the dielectric strength is less than 26 kilovolts, filter the oil as described in paragraph 5-76.

j. Close and secure the ac control panel.

5-76. FILTERING AND RECLAIMING TRANSFORMER OIL.

5-77. Transformer oil containing carbon, water, and insoluble contaminants can be restored to good operating condition in many instances by using a conventional filter press. Transformer oil contaminated with mineral oil sufficient to effect its nonflammable and nonexplosive characteristics cannot be reclaimed and must be discarded. The equipment required to filter the transformer oil consists of filter (General Electric Co. 7299ZR6799), filter paper, fuller's earth, flexible metal hose, and an oven for drying filter paper.

5-78. Filtration should be accomplished only when the beam power transformer has been in normal operation for at least 8 hours prior to filtration.

5-79. To filter and reclaim the transformer oil, refer to figure 5-7 and proceed as follows:

NOTE

The effectiveness of the filtering process is proportional to the care and thoroughness with which the filter paper and fuller's earth are dried initially.

a. Hang the filter paper approximately 1/8 inch or more apart in a drying oven and dry for 6 to 12 hours at a temperature of approximately 95°C (203°F) to 105°C (221°F).

b. Thoroughly dry 6 pounds of fuller's earth in shallow pans at 250°C (482°F) for 2 hours.

NOTE

The dry fuller's earth and filter paper should be installed in the filter press immediately after drying so they will not reabsorb moisture from the air. Filter paper exposed in normal atmosphere will reabsorb, in as little as 5 minutes, two-thirds of the moisture that it will ultimately take up.

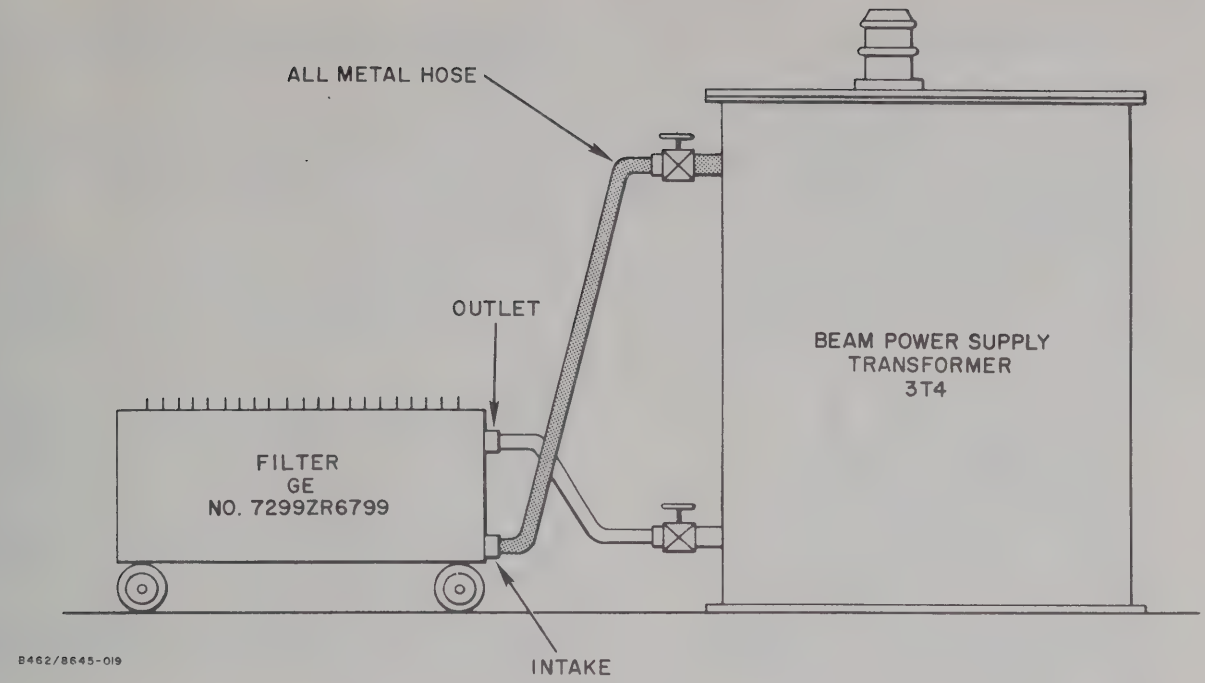


Figure 5-7. Transformer Oil Filter Test Setup

c. Properly mix the dry fuller's earth with clean transformer oil in the mixing tank of the filter.

d. Install the filter paper between the filter plate and the fuller's earth mixture.

e. Loosen the knurled knobs on the ac control panel and swing the panel completely open.

f. Thoroughly clean the threads and interiors of the upper filter press and oil drainage valves.

CAUTION

Use only a metal hose in handling transformer oil. A hose made from, or lined with, rubber deteriorates rapidly, giving up sulfur which is detrimental to the oil.

g. Connect the flexible metal hose from the filter intake to the upper filter press of the beam power transformer.

h. Connect the flexible metal hose from the filter outlet to the oil drainage valve of the beam power transformer.

i. Open the valves on the beam power transformer and turn on the filtration equipment.

j. Test the dielectric strength of the transformer oil every hour during the filtering process as described in paragraph 5-72.

k. Continue the filtering process until the transformer oil meets the dielectric strength and insulation resistance requirements specified.

l. Disconnect the filtration equipment.

m. Check and add oil if necessary as described in paragraph 5-80.

n. Vacuum remove any trapped air bubbles as described in paragraph 5-83.

o. Close and secure the ac control panel.

5-80. CHECKING LEVEL AND ADDING TRANSFORMER OIL.

5-81. The level of the transformer oil should be checked periodically, in addition, it should be checked after the transformer oil has been filtered and reclaimed.

5-82. To check the transformer oil level and add transformer oil where necessary proceed as follows:

a. Loosen the two knurled knobs on the ac control panel and swing the panel open, if this has not previously been accomplished.

b. Check the OIL LEVEL gauge on the front of the tank. The gauge should read at approximately midscale.

NOTE

If it is necessary to add transformer oil, use nonflammable Amertran Abestol (American Transformer Division, Radio Engineering Laboratories, Inc.), Askarel (Monsanto Chemical Co.), or Pyranol 1467 (General Electric Co.). Do not substitute any other transformer oil.

WARNING

Ventilate the area while adding oil since transformer oil may emit toxic fumes. Contact between oil and skin or clothing should be avoided because of the corrosive agents the oil contains. Safety goggles should be worn because these corrosive agents are also particularly harmful to the eyes.

c. If transformer oil is required, remove the blowout assembly (fig. 5-8).

d. Using a clean funnel, fill the tank to the correct level.

e. Replace the blowout assembly.

f. Vacuum remove any trapped air as described in paragraph 5-83.

g. Close and secure the ac control panel.

5-83. VACUUM REMOVAL OF TRAPPED AIR.

5-84. Trapped air bubbles will remain in the transformer oil of the beam power supply transformer after addition of oil, oil filtering, or raising of core and coil. Trapped air is a potential source of trouble. Therefore, it is necessary to vacuum remove all air bubbles before operating the beam power transformer.

5-85. To vacuum remove the trapped air bubbles from the oil of the beam power transformer refer to figure 5-8 and proceed as follows:

a. Connect a valve to a suitable length of pipe with a flange that matches the flange of the blowout assembly. Bolt the pipe assembly to the blowout assembly on top of the beam power transformer.

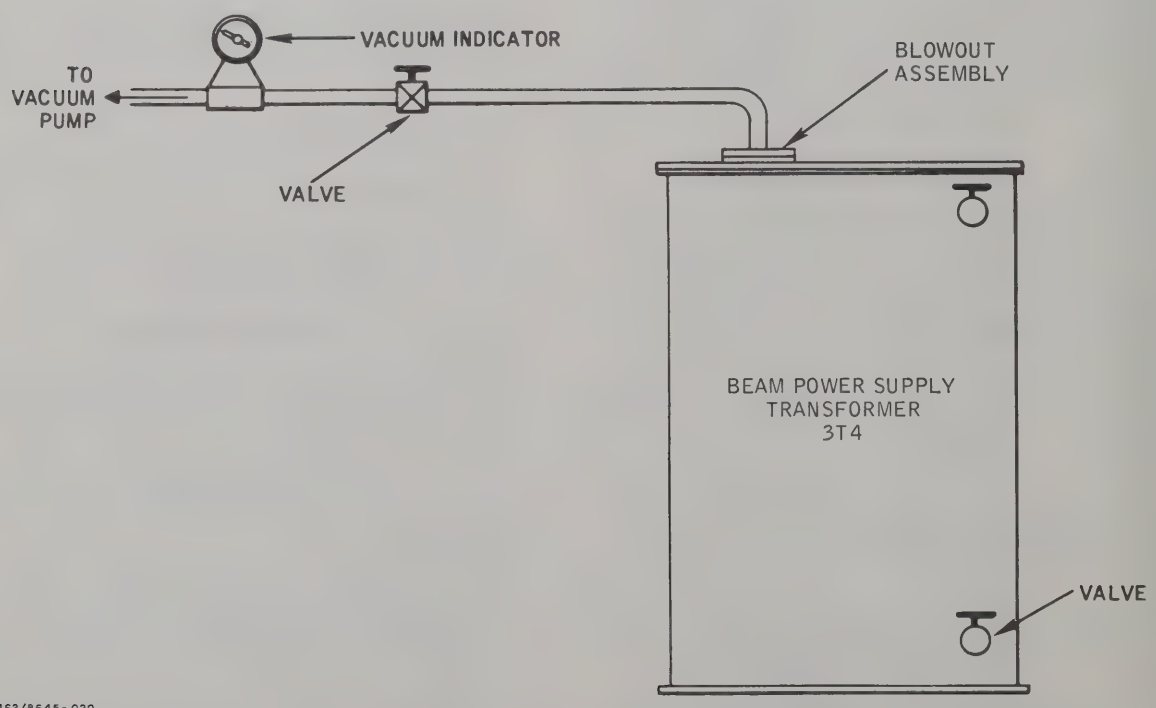


Figure 5-8. Test Setup for Vacuum Removal of Trapped Air from Beam Power Supply Transformer

b. Connect a vacuum pump with a vacuum indicator to the other end of the valve.

c. Turn on the vacuum pump and adjust the pressure to 0.96 psia (50 mm hg).

NOTE

If the vacuum cannot be maintained, pressure test the beam power supply as described in paragraph 5-86.

d. Allow the pump to operate at this pressure for a minimum of 1 hour.

e. Remove the test equipment and return the beam power transformer to normal operation.

5-86. PRESSURE TESTING OF BEAM POWER TRANSFORMER.

5-87. Pressure testing of the beam power transformer is extremely important and must be done after replacement of bushings, gaskets, and other accessories. If the tank of the beam power transformer is not pressure-tight, moisture-laden air may enter the beam power transformer causing high voltage arcing between the transformer windings.

5-88. Pressure test the beam power transformer as follows:

a. Remove the beam power transformer from the 10-kw power amplifier cabinet as described in paragraph 5-66.

b. Make the test hookup to the blowout assembly as shown in figure 5-9.

c. Check the reading on the pressure gauge. An average reading of 4 to 6 psi is an indication that the beam power transformer is pressure tight.

d. If no internal pressure is indicated on the pressure gauge, proceed with step e.

e. Inspect the exterior of the tank below the oil level for evidence of leaks.

f. Connect a nitrogen source to the hose coupler of the 1/4-inch valve and open the valve.

g. Force nitrogen into the tank until a pressure of 6 psi is indicated on the pressure gauge. Maintain the pressure for 12 hours.

h. Apply liquid soap solution to all areas where leaks may occur. Leaks will be evidenced by soap bubbles.

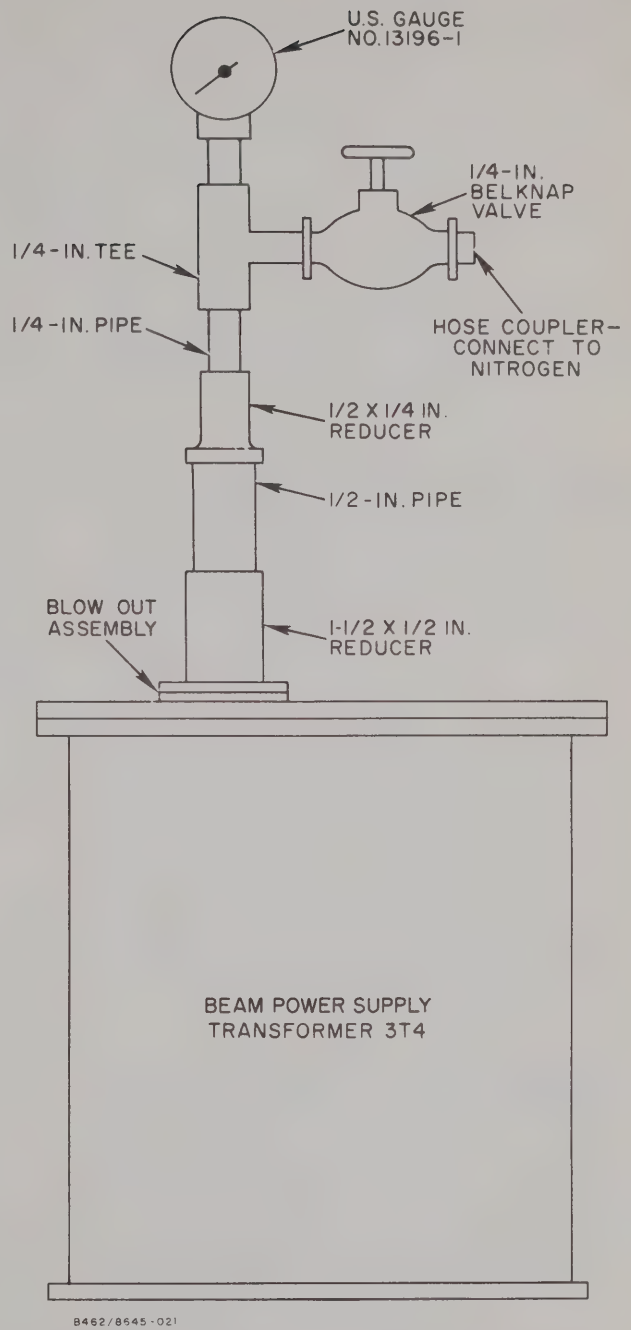


Figure 5-9. Beam Power Supply Transformer Pressure-test Setup

i. After all leaks have been repaired, repeat the test until no leaks appear during 12 consecutive hours of testing.

j. Remove the test equipment and return the beam power transformer to normal.

k. Reinstall the beam power transformer in accordance with the instructions given in paragraph 2-31.

l. Close and secure the ac control panel.

CHAPTER 6

CIRCUIT DIAGRAMS

6-1. SCOPE. This manual provides the following types of circuit diagrams: an overall schematic diagram, schematic diagrams of all assemblies, an across-the-line (functional schematic) diagram showing the control circuitry, and a wiring diagram of the 10-kw power amplifier cabinet.

6-2. MODIFICATIONS. All applicable manufacturers' modifications have been included in these circuit diagrams. Where minor changes due to the modifications have been made to the circuit diagrams, the original circuitry is either shown on the basic circuit diagram or is indicated by notes.

6-3. ALTERED CIRCUIT DIAGRAMS. Extensive modifications are covered by altered circuit diagrams. These are printed with the same figures numbers as the basic circuits, but suffixed with a decimal number. For example, figure 6-6.1 reflects a change to control panel 3A3.

6-4. ARRANGEMENT. The overall circuit diagrams are presented first. These include the across-the-line diagram, the cabinet wiring diagram, and the overall schematic diagram, in that order. These diagrams are followed by schematic diagrams of all assemblies arranged according to reference designation number (i.e., 3A1, 3A2, etc.). Parts location diagrams, keyed to appendix A, are also included (fig. 6-16 through 6-20).

6-5. CIRCUIT DIAGRAM REFERENCE DATA. Except for the special symbols listed in table 1, all electrical and electronic graphic symbols conform to specification MIL-STD-15-1A. Abbreviations used in this manual are in accordance with MIL-STD-12B. The following statements are applicable to circuit diagrams contained in this manual:

a. Component Values. Except where otherwise indicated, all resistance values are in ohms and all resistors are 1/2 watt; all capacitance values are in micromicrofarads; all inductance values are in microhenries. Inductor, choke and transformer resistance values are shown only on assembly schematic diagrams. Where the dc resistance of an indicator, choke, or transformer is less than one ohm, the resistance is not shown.

b. Voltage Measurements and Voltage-Resistance Charts. Voltage readings shown in this manual were obtained on a multimeter having sensitivities of 20,000 ohms-per-volt dc and 3000 ohms-per-volt ac. With the exception of the high-voltage klystron tube, the 10-kw power amplifier contains no tube sockets. For this reason, voltage and resistance data for tube sockets are not applicable and are not included in this manual.

Table 6-1. Special Symbols

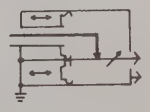
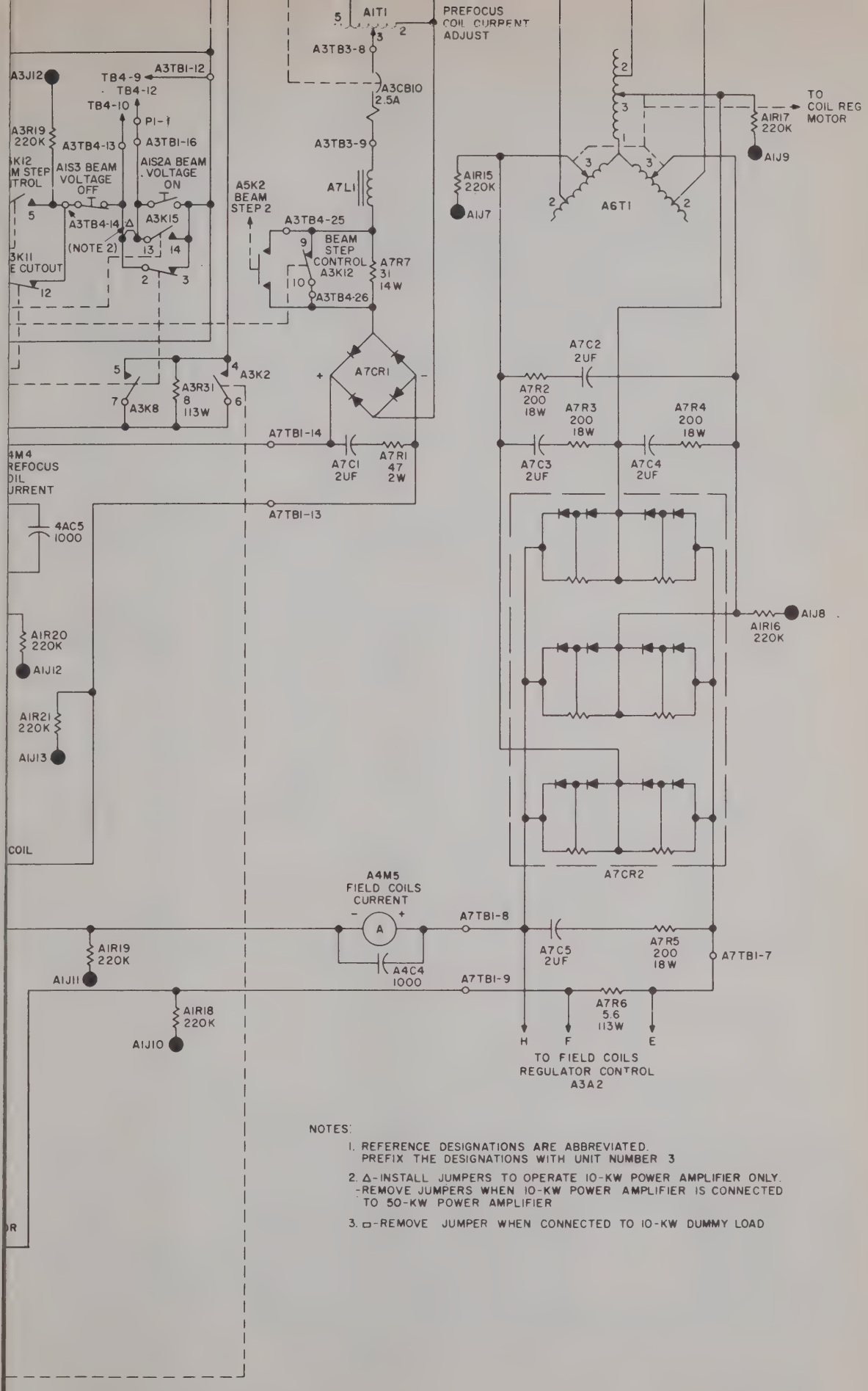
Meter-relay	
Input cavity	

TABLE 6-2.

CROSS-REFERENCE INDEX

Common Name	Official Nomenclature or Part Number	Page No.
AC control panel	Panel, Power Distribution SB-1193/FRC-39A(V)	6-8
Alarm power supply	Power Supply PP-2744/FRC-39A(V)	6-12
Beam power primary control	Control, Power Supply C-3395/FRC-39A(V)	6-15
Beam power primary control	Control, Power Supply C-6126/URA-48	6-15
Beam power transformer	Unassigned	6-18
Beam regulator control panel	Control Power Supply 3-3398/FRC-39A(V)	6-13
Distribution panel	Panel, Power Distribution SB-1192/FRC-39A(V)	6-8
Distribution panel	Panel, Power Distribution SB-1847/MRC-98	6-6
Field coils regulator control panel	Control, Power Supply C-3397/FRC-39A(V)	6-4
Field coils variable autotransformer	Transformer, Variable, Power TF-355/FRC-39A(V)	6-16
Focus coils power supply	Power Supply PP-2745/FRC-39A(V)	6-17
Klystron carriage	Amplifier, Radio Frequency AM-2752/FRC-39A(V)	6-7
Klystron carriage	Amplifier, Radio Frequency AM-3629/MRC-98	6-7
Meter panel	Panel, Monitor SB-1194/FRC-39A(V)	6-14
10-KW power amplifier	Amplifier-Power Supply Group OA-2973/FRC-39A(V)	6-5
10-KW power amplifier	Amplifier - Power Supply Group OA-4408/MRC-98	6-5
10-KW power amplifier cabinet	Cabinet, Electrical Equipment CY-2981/FRC-39A(V)	6-4
10-KW power amplifier cabinet	Cabinet, Electrical Equipment CY-3794/MRC-98	6-4
120-Volt regulator control panel	Control, Power Supply C-3396/FRC-39A(V)	6-10



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH UNIT NUMBER 3
2. Δ-INSTALL JUMPERS TO OPERATE 10-KW POWER AMPLIFIER ONLY. -REMOVE JUMPERS WHEN 10-KW POWER AMPLIFIER IS CONNECTED TO 50-KW POWER AMPLIFIER
3. ▭-REMOVE JUMPER WHEN CONNECTED TO 10-KW DUMMY LOAD

Figure 6-1.10-KW Power Amplifier Across-The-Line Diagram

TABLE 6-2.

CROSS-REFERENCE INDEX

Common Name	Official Nomenclature or Part Number	Page No.
AC control panel	Panel, Power Distribution SB-1193/FRC-39A(V)	6-8
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Beam power primary control	Control, Power Supply C-6126/URA-48	6-15
Beam power transformer	Unassigned	6-18
Beam regulator control panel	Control Power Supply 3-3398/FRC-39A(V)	6-13
Distribution panel	Panel, Power Distribution SB-1192/FRC-39A(V)	6-8
Distribution panel	Panel, Power Distribution SB-1847/MRC-98	6-6
Field coils regulator control panel	Control, Power Supply C-3397/FRC-39A(V)	6-4
Field coils variable autotransformer	Transformer, Variable, Power TF-355/FRC-39A(V)	6-16
Focus coils power supply	Power Supply PP-2745/FRC-39A(V)	6-17
Klystron carriage	Amplifier, Radio Frequency AM-2752/FRC-39A(V)	6-7
Klystron carriage	Amplifier, Radio Frequency AM-3629/MRC-98	6-7
Meter panel	Panel, Monitor SB-1194/FRC-39A(V)	6-14
10-KW power amplifier	Amplifier-Power Supply Group OA-2973/FRC-39A(V)	6-5
10-KW power amplifier	Amplifier - Power Supply Group OA-4408/MRC-98	6-5
10-KW power amplifier cabinet	Cabinet, Electrical Equipment CY-2981/FRC-39A(V)	6-4
10-KW power amplifier cabinet	Cabinet, Electrical Equipment CY-3794/MRC-98	6-4
120-Volt regulator control panel	Control, Power Supply C-3396/FRC-39A(V)	6-10

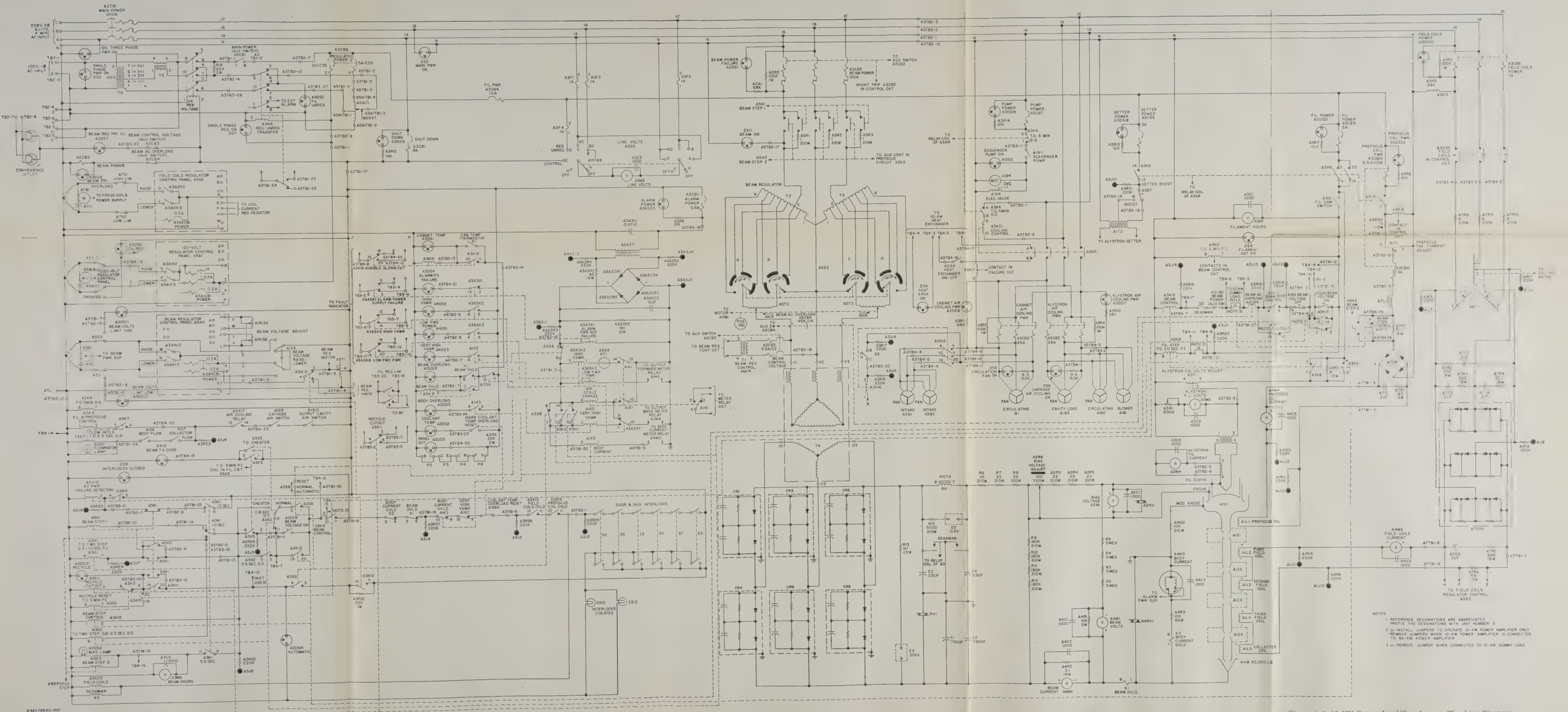
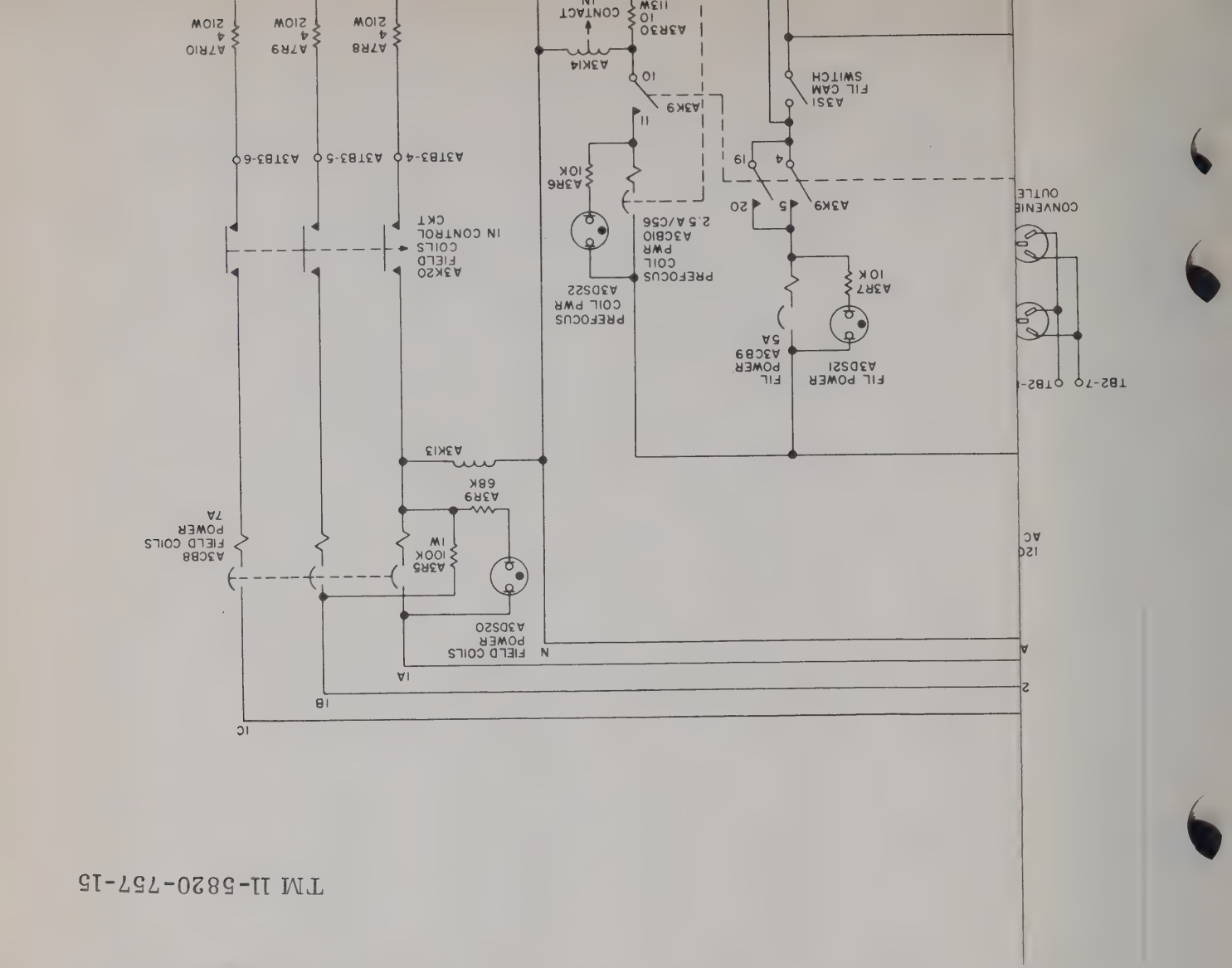


Figure 6-1.10-KW Power Amplifier Across-The-Line Diagram



TM 11-5820-757-15

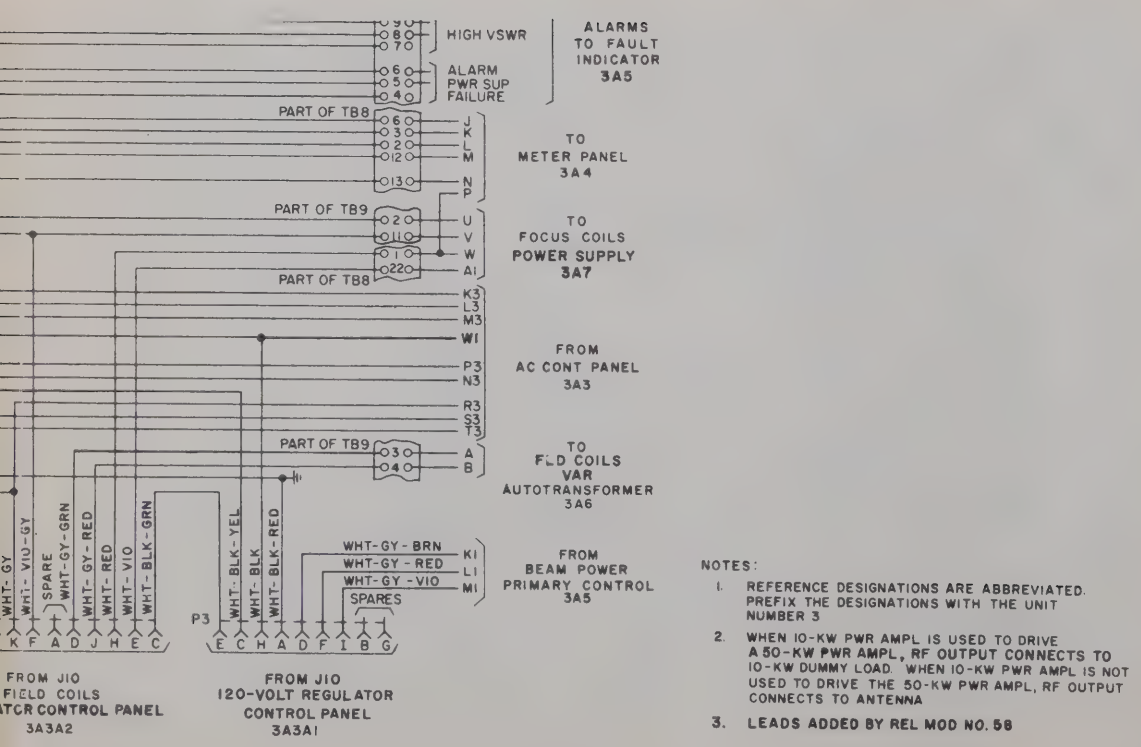
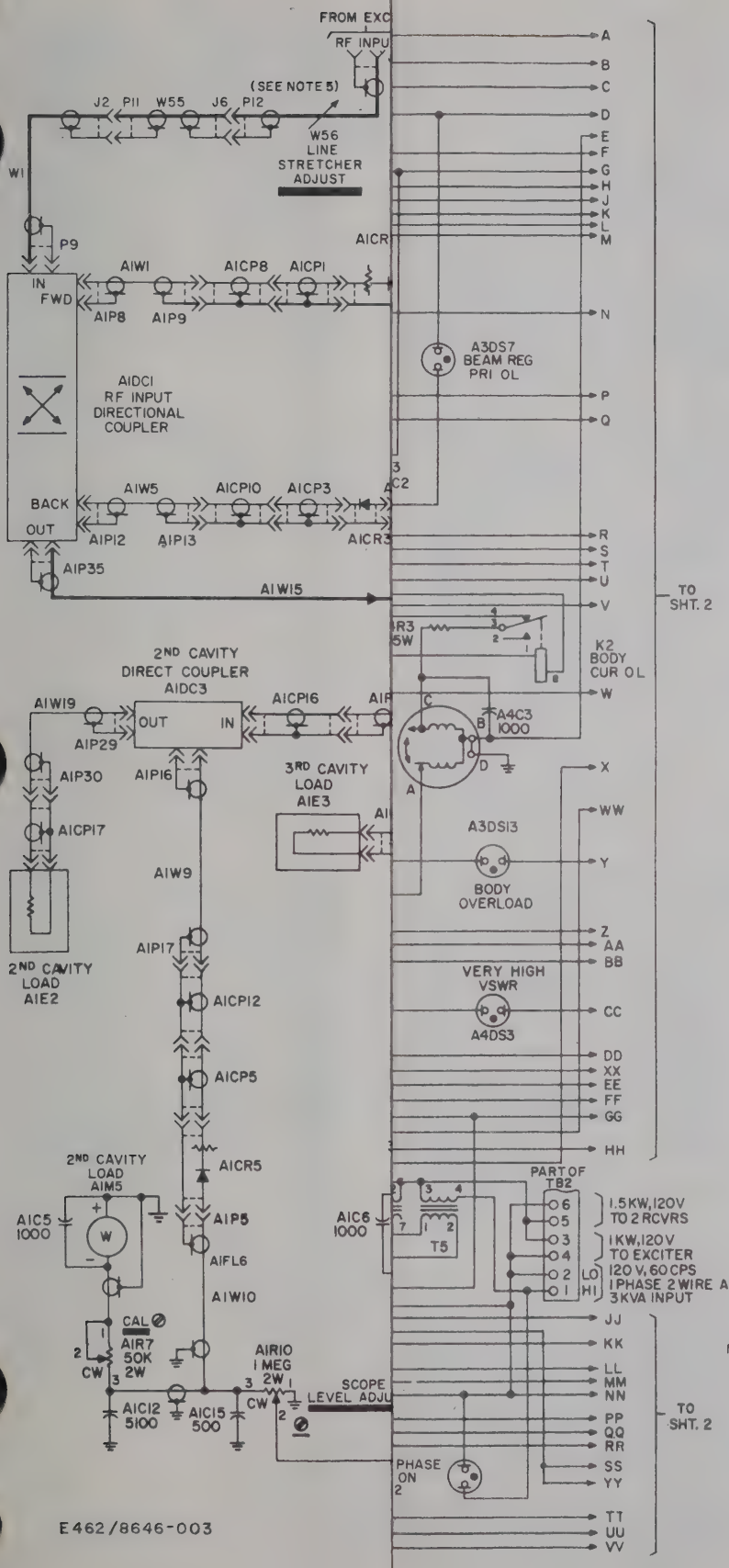


Figure 6-2. 10-KW Power Amplifier Cabinet, Wiring Diagram



BETWEEN TEST JACKS	VOLTAGE
3A1J7 - 3A1J8	170 - 260V AC
3A1J8 - 3A1J9	170 - 260V AC
3A1J9 - 3A1J7	170 - 260V AC
3A1J10 - 3A1J11	250 - 400V DC
3A1J12 - 3A1J13	0 - 30V DC
3A3J1 - 3A3J2	85 - 120V AC
3A3J1 - 3A3J3	85 - 140V AC
3A3J1 - 3A3J4	85 - 140V AC
3A3J1 - 3A3J5	85 - 140V AC
3A3J1 - 3A3J6	85 - 140V AC
3A3J1 - 3A3J7	85 - 140V AC
3A3J1 - 3A3J8	85 - 140V AC
3A3J1 - 3A3J9	85 - 140V AC
3A3J1 - 3A3J10	85 - 140V AC
3A3J1 - 3A3J11	85 - 140V AC
3A3J1 - 3A3J12	85 - 140V AC
3A3J1 - 3A3J13	85 - 140V AC
3A3J1 - 3A3J14	85 - 140V AC
3A3J1 - 3A3J15	85 - 140V AC
3A3J1 - 3A3J16	0V
3A3A1J1 - 3A3J1	0V
* 3A3A1J1 - 3A3J1	85 - 140V AC
3A3A1J2 - 3A3J1	0V
* 3A3A1J2 - 3A3J1	85 - 140V AC
3A3A1J3 - 3A3A1J4	37 - 42V DC
3A3A1J3 - 3A3A1J5	65 - 75V DC
3A3A1J7 - 3A3J1	0V
* 3A3A1J7 - 3A3J1	85 - 140V AC
3A3A1J8 - 3A3J1	85 - 140V AC
3A3A1J9 - 3A3J1	0V
* 3A3A1J9 - 3A3J1	85 - 140V AC
3A3A2J1 - 3A3J1	0V
* 3A3A2J1 - 3A3J1	85 - 140V AC
3A3A2J2 - 3A3J1	0V
* 3A3A2J2 - 3A3J1	85 - 140V AC
3A3A2J3 - 3A3A2J4	11 - 14V DC
3A3A2J3 - 3A3A2J5	13 - 16V DC
3A3A2J7 - 3A3J1	0V
* 3A3A2J7 - 3A3J1	85 - 140V AC
3A3A2J8 - 3A3J1	85 - 140V AC
3A3A2J9 - 3A3J1	0V
* 3A3A2J9 - 3A3J1	85 - 140V AC
3A3A3J1 - 3A3A3J2	45 - 90V DC
3A3A3J3 - 3A3A3J4	85 - 140V AC
3A3A4J1 - 3A3J1	0V
* 3A3A4J1 - 3A3J1	85 - 140V AC
3A3A4J2 - 3A3J1	0V
* 3A3A4J2 - 3A3J1	85 - 140V AC
3A3A4J3 - 3A3A4J4	18 - 22V DC
3A3A4J3 - 3A3A4J5	65 - 75V DC
3A3A4J7 - 3A3J1	0V
* 3A3A4J7 - 3A3J1	85 - 140V AC
3A3A4J8 - 3A3J1	85 - 140V AC
3A3A4J9 - 3A3J1	0V
* 3A3A4J9 - 3A3J1	85 - 140V AC

* REGULATION CIRCUIT IN OPERATION.

NOTES:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3
2. WHEN 10-KW PWR AMPL IS USED TO DRIVE THE 50-KW PWR AMPL, RF OUTPUT LINE CONNECTS TO 10-KW DUMMY LOAD. WHEN 10-KW PWR AMPL IS NOT USED TO DRIVE THE 50-KW PWR AMPL, RF OUTPUT LINE CONNECTS TO ANTENNA.
3. TB4-5 AND TB4-6 CONNECTED DURING 10-KW OPERATION ONLY
4. ATTENUATOR AT2 ADDED BY REL MOD. 50
5. LINE STRETCHER W56 ADDED BY REL MOD. 57

Power Amplifier, Schematic Diagram (Sheet 1 of 2)

Figure 2

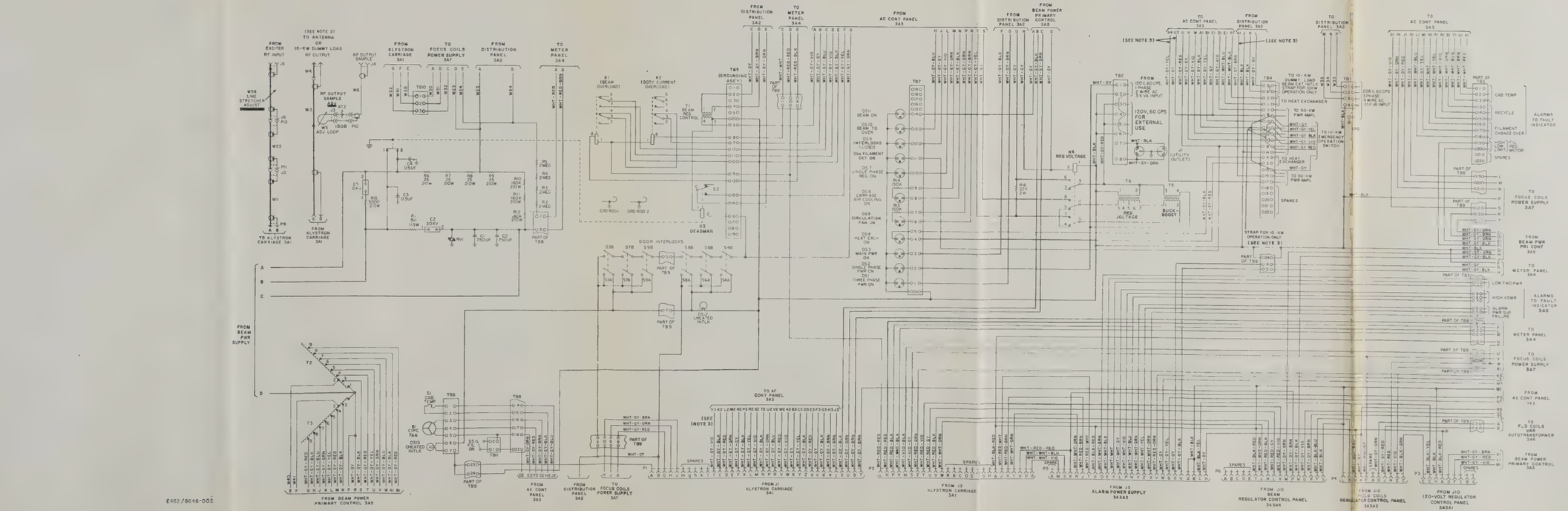
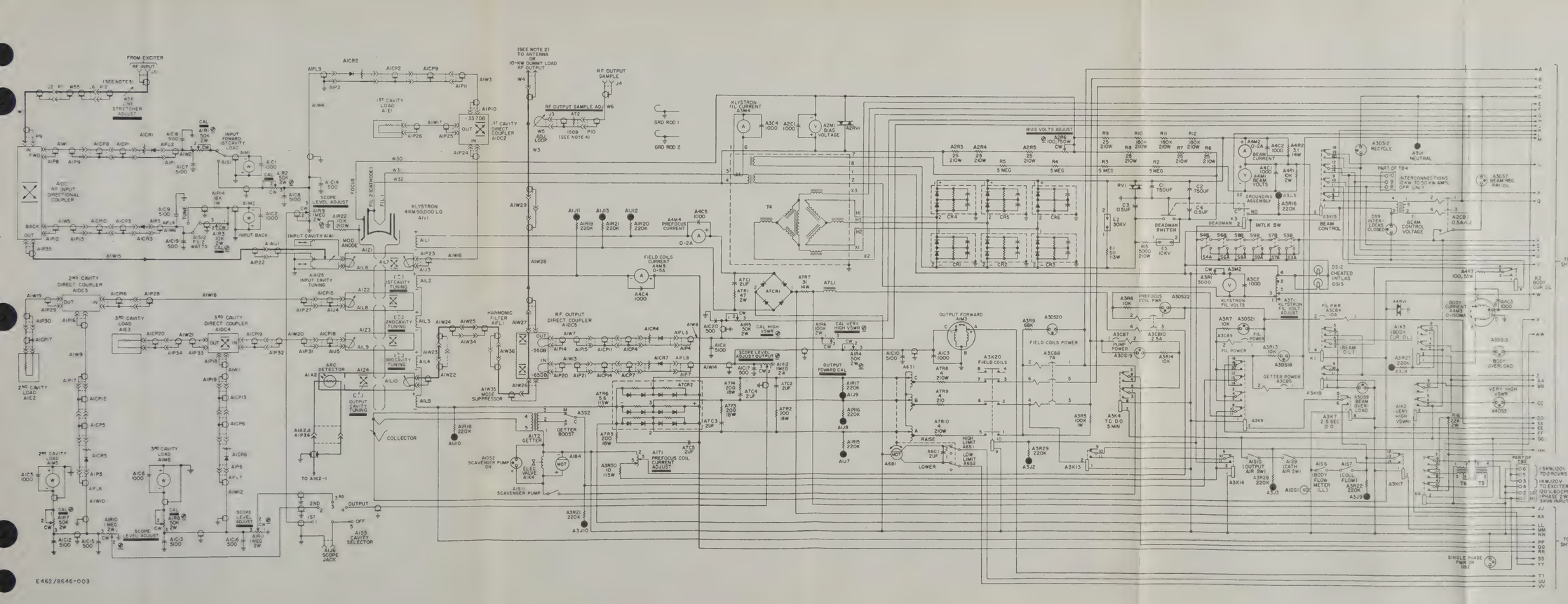


Figure 6-2. 10-KW Power Amplifier Cabinet, Wiring Diagram

NOTES

1. REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX THE DESIGNATIONS WITH THE UNIT NUMBER 3
2. WHEN 10-KW PWR AMPL IS USED TO DRIVE A 50-KW PWR AMPL, RF OUTPUT CONNECTS TO 10-KW DUMMY LOAD. WHEN 10-KW PWR AMPL IS NOT USED TO DRIVE THE 50-KW PWR AMPL, RF OUTPUT CONNECTS TO ANTENNA
3. LEADS ADDED BY REL MOD NO. 98



BETWEEN TEST JACKS	VOLTAGE
3A1J7 - 3A1J8	170 - 260V AC
3A1J8 - 3A1J9	170 - 260V AC
3A1J9 - 3A1J7	170 - 260V AC
3A1J10 - 3A1J11	250 - 400V DC
3A1J12 - 3A1J13	0 - 30V DC
3A3J1 - 3A3J2	85 - 120V AC
3A3J1 - 3A3J3	85 - 140V AC
3A3J1 - 3A3J4	85 - 140V AC
3A3J1 - 3A3J5	85 - 140V AC
3A3J1 - 3A3J6	85 - 140V AC
3A3J1 - 3A3J7	85 - 140V AC
3A3J1 - 3A3J8	85 - 140V AC
3A3J1 - 3A3J9	85 - 140V AC
3A3J1 - 3A3J10	85 - 140V AC
3A3J1 - 3A3J11	85 - 140V AC
3A3J1 - 3A3J12	85 - 140V AC
3A3J1 - 3A3J13	85 - 140V AC
3A3J1 - 3A3J14	85 - 140V AC
3A3J1 - 3A3J15	85 - 140V AC
3A3J1 - 3A3J16	0V
3A3A1J1 - 3A3J1	0V
* 3A3A1J2 - 3A3J1	85 - 140V AC
3A3A1J3 - 3A3A1J4	37 - 42V DC
3A3A1J5 - 3A3A1J5	65 - 75V DC
3A3A1J7 - 3A3J1	0V
* 3A3A1J7 - 3A3J1	85 - 140V AC
* 3A3A1J8 - 3A3J1	85 - 140V AC
3A3A1J9 - 3A3J1	0V
* 3A3A2J1 - 3A3J1	85 - 140V AC
* 3A3A2J1 - 3A3J1	0V
3A3A2J2 - 3A3J1	0V
* 3A3A2J3 - 3A3J1	85 - 140V AC
3A3A2J3 - 3A3A2J4	11 - 16V DC
3A3A2J5 - 3A3A2J6	12 - 16V DC
3A3A2J7 - 3A3J1	0V
* 3A3A2J7 - 3A3J1	85 - 140V AC
3A3A2J8 - 3A3J1	85 - 140V AC
* 3A3A2J7 - 3A3J1	0V
* 3A3A2J7 - 3A3J1	85 - 140V AC
3A3A3J1 - 3A3A3J2	45 - 90V DC
3A3A3J3 - 3A3A3J4	85 - 140V AC
3A3A3J1 - 3A3J1	0V
* 3A3A4J1 - 3A3J1	85 - 140V AC
3A3A4J2 - 3A3J1	0V
* 3A3A4J2 - 3A3J1	85 - 140V AC
* 3A3A4J3 - 3A3A4J4	13 - 27V DC
3A3A4J3 - 3A3A4J5	65 - 75V DC
* 3A3A4J7 - 3A3J1	0V
* 3A3A4J7 - 3A3J1	85 - 140V AC
* 3A3A4J8 - 3A3J1	85 - 140V AC
* 3A3A4J9 - 3A3J1	0V
* 3A3A4J9 - 3A3J1	85 - 140V AC

* REGULATION CIRCUIT IN OPERATION.

NOTES
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3
2. WHEN 10-KW PWR AMPL IS USED TO DRIVE THE 50-KW PWR AMPL, RF OUTPUT LINE CONNECTS TO 10-KW DUMMY LOAD. WHEN 10-KW PWR AMPL IS NOT USED TO DRIVE THE 50-KW PWR AMPL, RF OUTPUT LINE CONNECTS TO ANTENNA
3. TB4-5 AND TB4-6 CONNECTED DURING 10-KW OPERATION ONLY
4. ATTENUATOR AT2 ADDED BY REL MOD. 80
5. LINE STRETCHER W66 ADDED BY REL MOD. 97

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Figure 6-3.10-KW Power Amplifier, Schematic Diagram (Sheet 1 of 2)

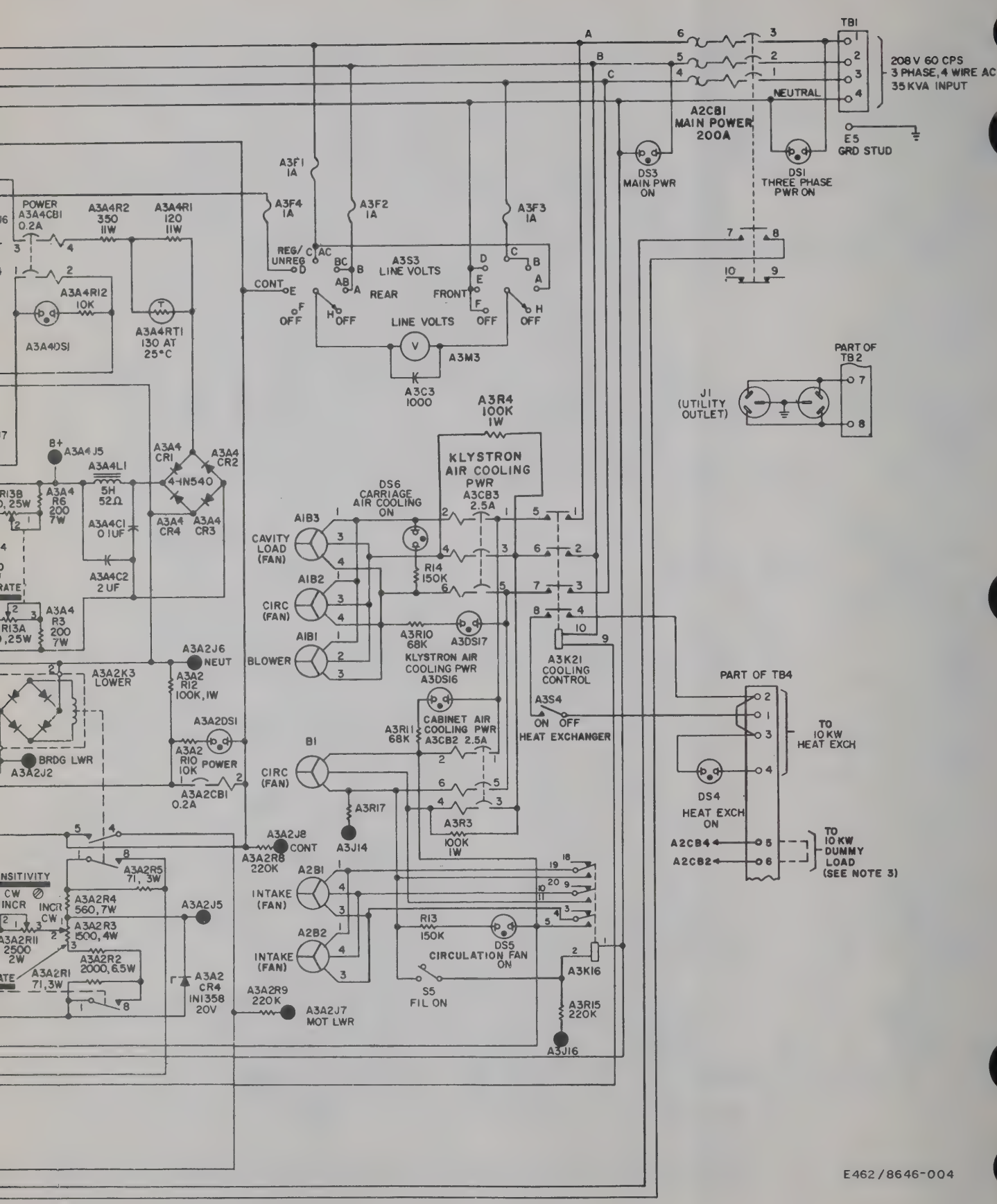
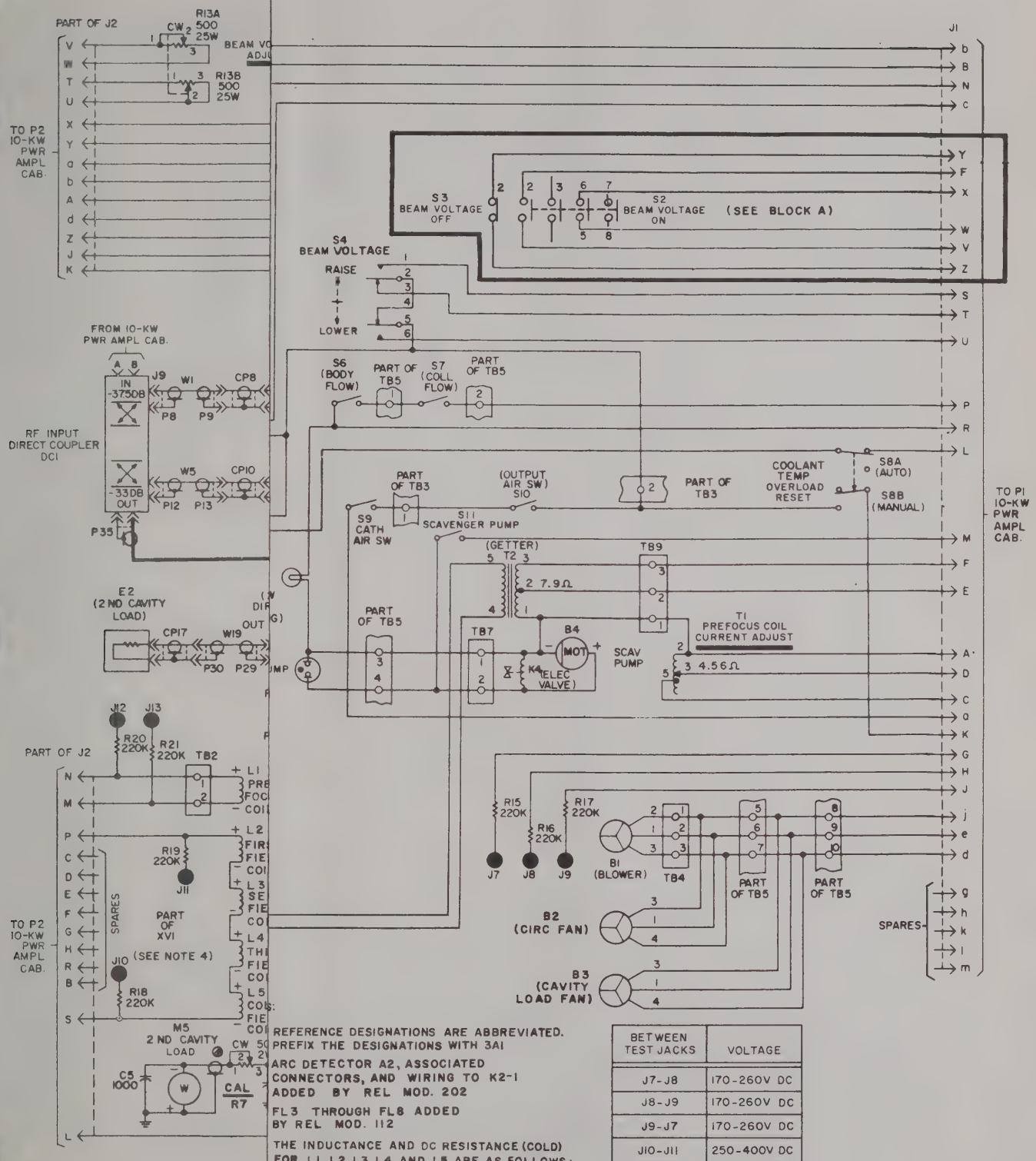


Figure 6-3. 10-KW Power Amplifier, Schematic Diagram (Sheet 2 of 2)



REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A1

ARC DETECTOR A2, ASSOCIATED CONNECTORS, AND WIRING TO K2-1 ADDED BY REL MOD. 202

FL3 THROUGH FL8 ADDED BY REL MOD. 112

THE INDUCTANCE AND DC RESISTANCE (COLD) FOR L1, L2, L3, L4 AND L5 ARE AS FOLLOWS:

	RESISTANCE		
DIL	MIN	MAX	INDUCTANCE
L1	17.5Ω	20.0Ω	0.12 HY ± 5%
L2	20.1Ω	22.2Ω	0.22 HY ± 5%
L3	28.1Ω	33.3Ω	0.22 HY ± 5%
L4	27.0Ω	33.0Ω	0.24 HY ± 5%
L5	6.65Ω	8.60Ω	0.05 HY ± 5%

BETWEEN TEST JACKS	VOLTAGE
J7-J8	170-260V DC
J8-J9	170-260V DC
J9-J7	170-260V DC
J10-J11	250-400V DC
J12-J13	0-30V DC

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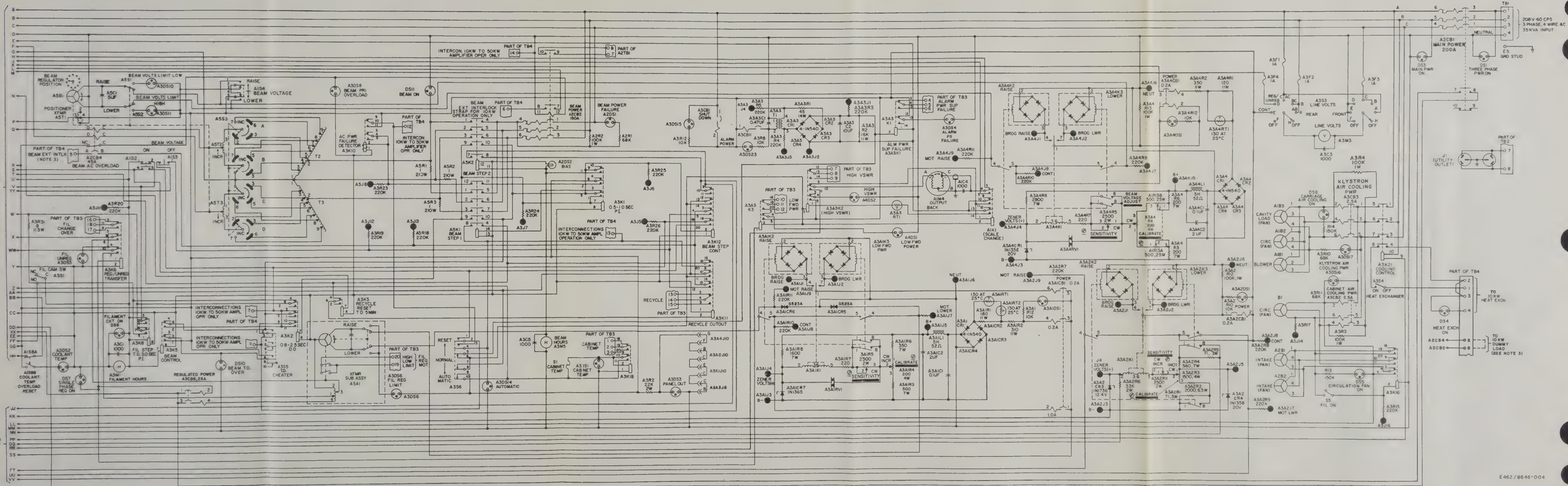
Figure 6-4. Klystron Carriage 3A1, Schematic Diagram


BEAM REGULATOR POSITION
RAISE
LOWER
BEAM VOLTS LIMIT LOW
BEAM VOLTS LIMIT HIGH
POSITIONER XFMR
BEAM VOLTAGE ON OFF
BEAM AC OVERLOAD
A1S4 BEAM VOLTAGE
AC PWR FAILURE DETECTOR A3K10
BEAM PRI OVERLOAD
DS11 BEAM ON
INTERCON 10KW TO 50KW AMPLIFIER OPER ONLY
BEAM EXT INTERLOCK STBY FOR 10KW OPERATION ONLY
BEAM STEP 2
BEAM STEP 1
BEAM POWER A3CB2 150A
BEAM POWER FAILURE A2DS1
ALARM POWER
A3CB1 SHUT DOWN
A3R12 10K
A2R1 68K
A2R2 100K 1W
A2R1 1 210W
A2R3 210W
A2D2 BIAS
A3R25 220K
A3J6
A3K1 0.5-10 SEC PI
A3K1 BEAM STEP 1
A3K1K2 BEAM STEP CONT
INTERCONNECTIONS 10KW TO 50KW AMPL OPERATION ONLY
RECYCLE
RECYCLE CUTOUT
A3K11
A3J4J10
A3J2J10
A3J1J10
A3J3J5
A3J5J6
A3J2J6
A3J1J5
A3J4J5
A3J3J4
A3J2J3
A3J1J2
A3J4J4
A3J3J3
A3J2J2
A3J1J1
A3J4J3
A3J3J2
A3J2J1
A3J1J6
A3J4J6
A3J3J1
A3J2J5
A3J1J5
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A3J1J14
A3J4J15
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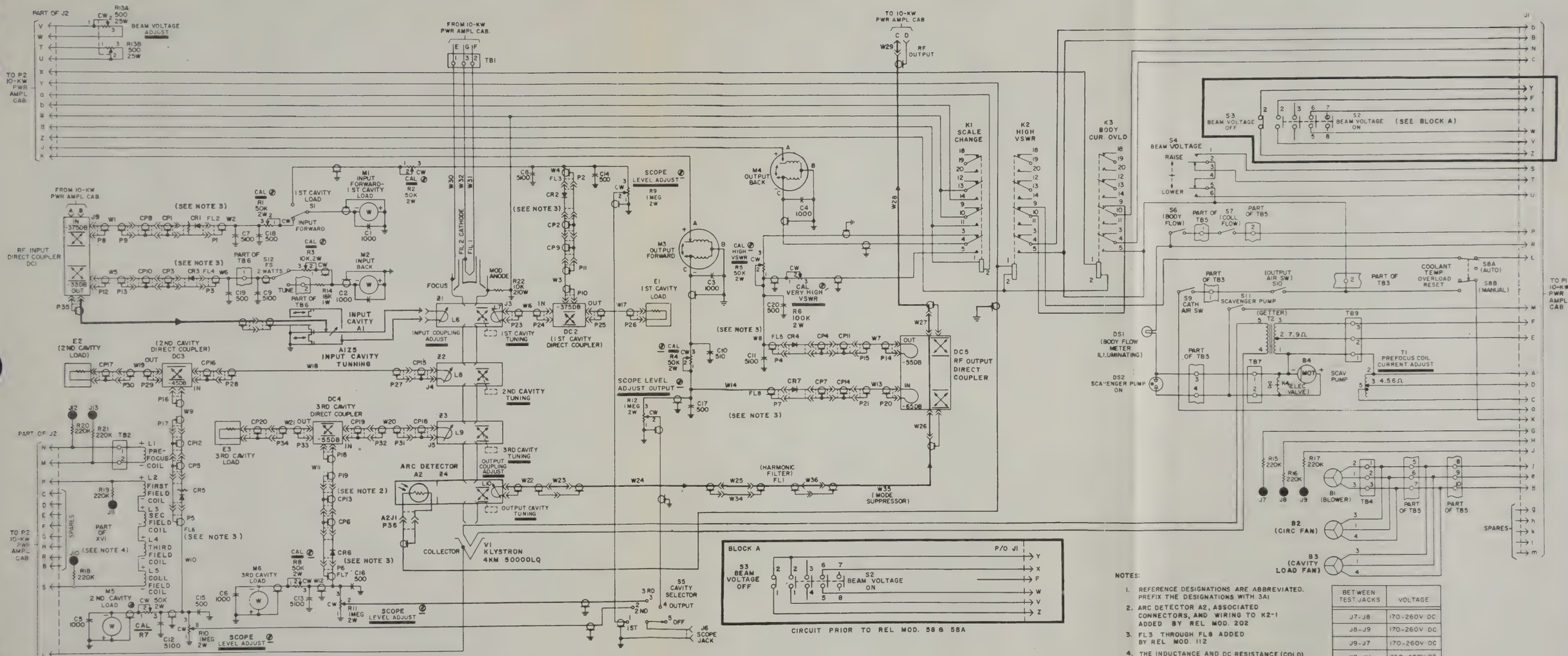
A3J4J16
A3J3J16
A3J2J16
A3J1J16



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A1
2. ARC DETECTOR A2, ASSOCIATED CONNECTORS, AND WIRING TO K2-1 ADDED BY REL MOD. 202
3. FL3 THROUGH FL8 ADDED BY REL MOD. 112
4. THE INDUCTANCE AND DC RESISTANCE (COLD) FOR L1, L2, L3, L4 AND L5 ARE AS FOLLOWS:

COIL	RESISTANCE MIN	RESISTANCE MAX	INDUCTANCE
L1	17.5Ω	20.0Ω	0.12 HY ± 5%
L2	20.1Ω	22.2Ω	0.22 HY ± 5%
L3	28.1Ω	33.3Ω	0.22 HY ± 5%
L4	27.0Ω	33.0Ω	0.24 HY ± 5%
L5	6.65Ω	8.60Ω	0.05 HY ± 5%

BETWEEN TEST JACKS	VOLTAGE
J7-J8	170-260V DC
J8-J9	170-260V DC
J9-J7	170-260V DC
J10-J11	250-400V DC
J12-J13	0-30V DC

Figure 6-4. Klystron Carriage 3A1, Schematic Diagram

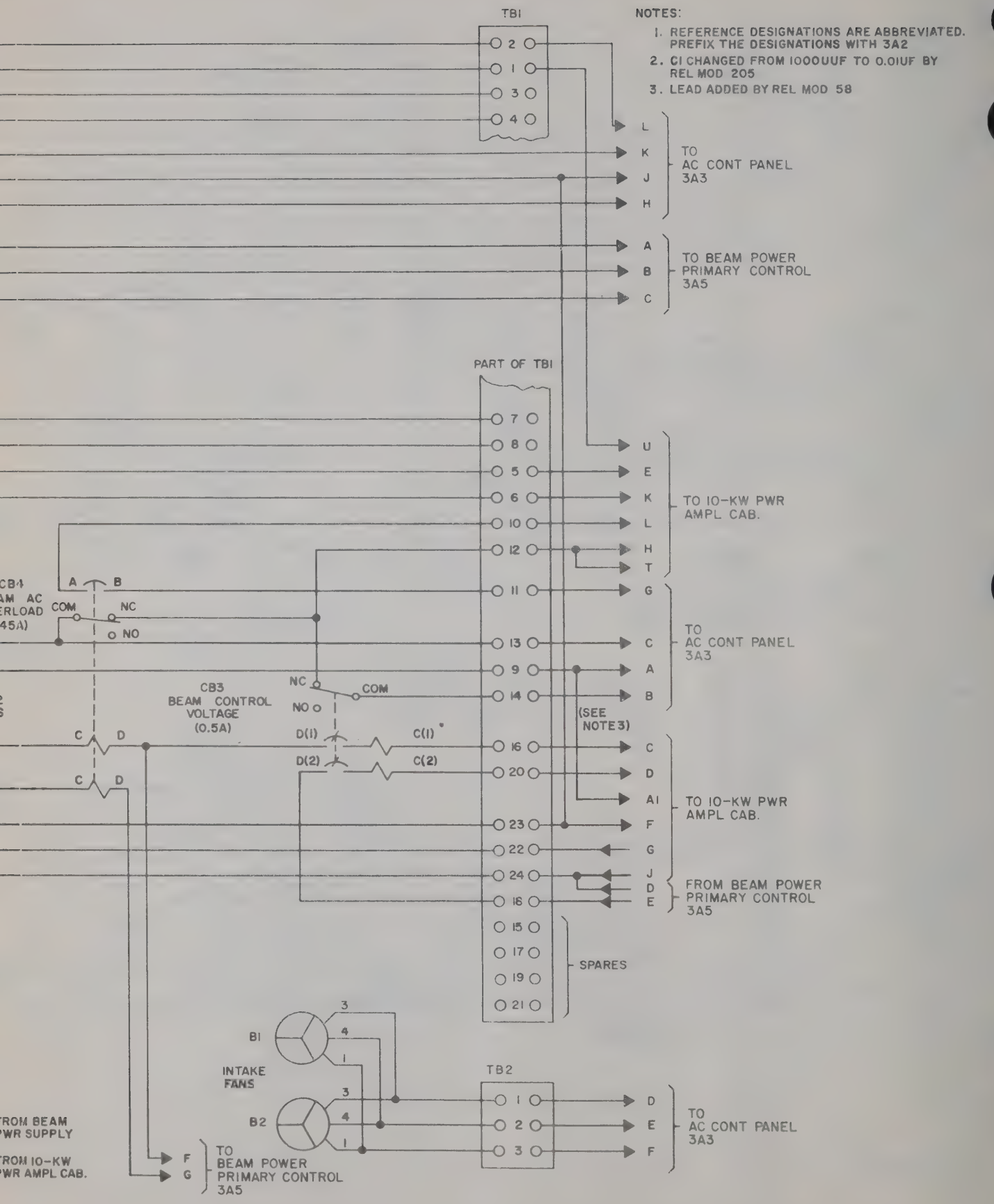
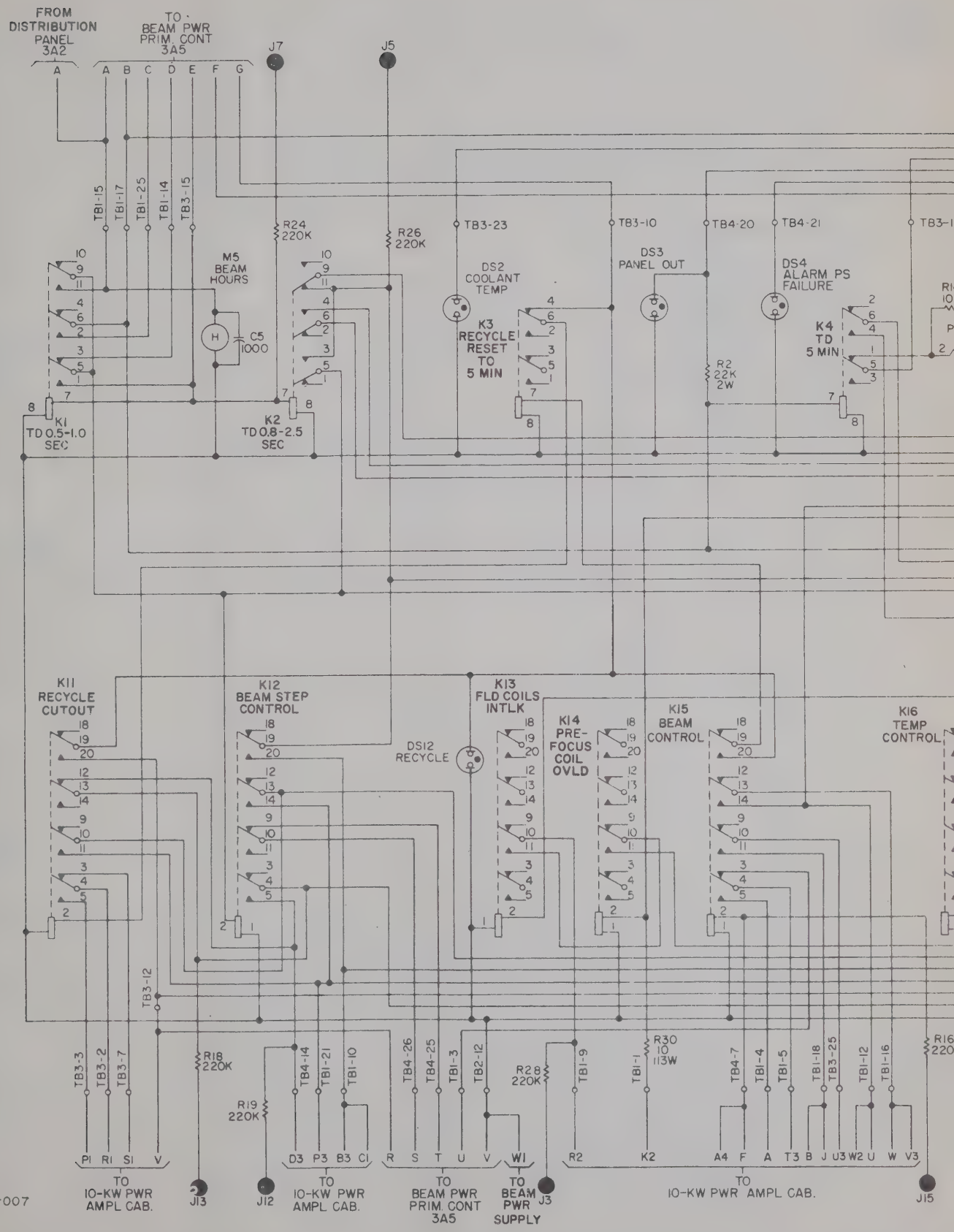


Figure 6-5. Distribution Panel 3A2, Schematic Diagram



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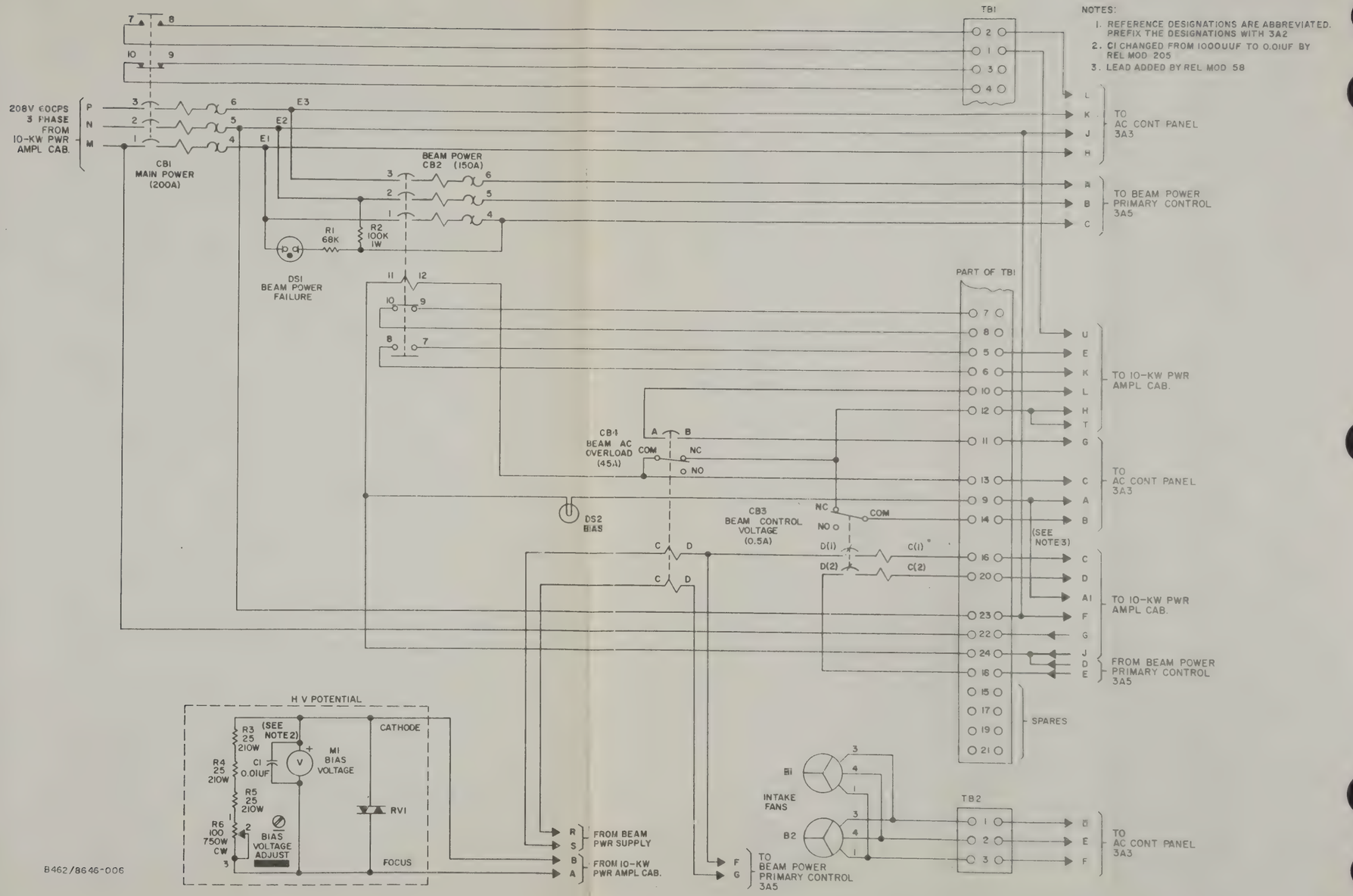
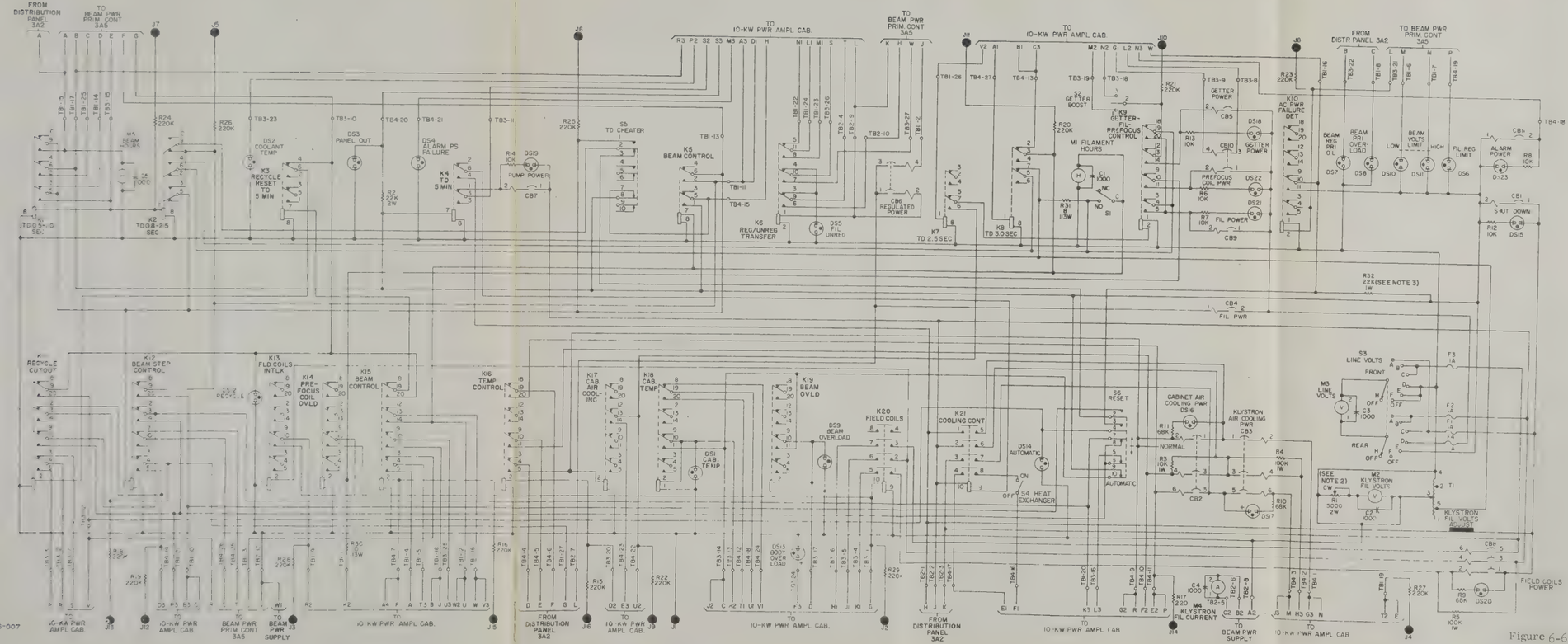


Figure 6-5. Distribution Panel 3A2, Schematic Diagram



Between Test Jacks	Voltage
J1 - J2	85 - 140V AC
J1 - J3	85 - 140V AC
J1 - J4	85 - 140V AC
J1 - J5	85 - 140V AC
J1 - J6	85 - 140V AC
J1 - J7	85 - 140V AC
J1 - J8	85 - 140V AC
J1 - J9	85 - 140V AC
J1 - J10	85 - 140V AC
J1 - J11	85 - 140V AC
J1 - J12	85 - 140V AC
J1 - J13	85 - 140V AC
J1 - J14	85 - 140V AC
J1 - J15	85 - 140V AC
J1 - J16	

NOTES:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A3.
2. R1 CHANGED FROM 2500 TO 5000 OHMS BY REL MOD NO. 7
3. R32 ADDED BY REL MOD NO. 58

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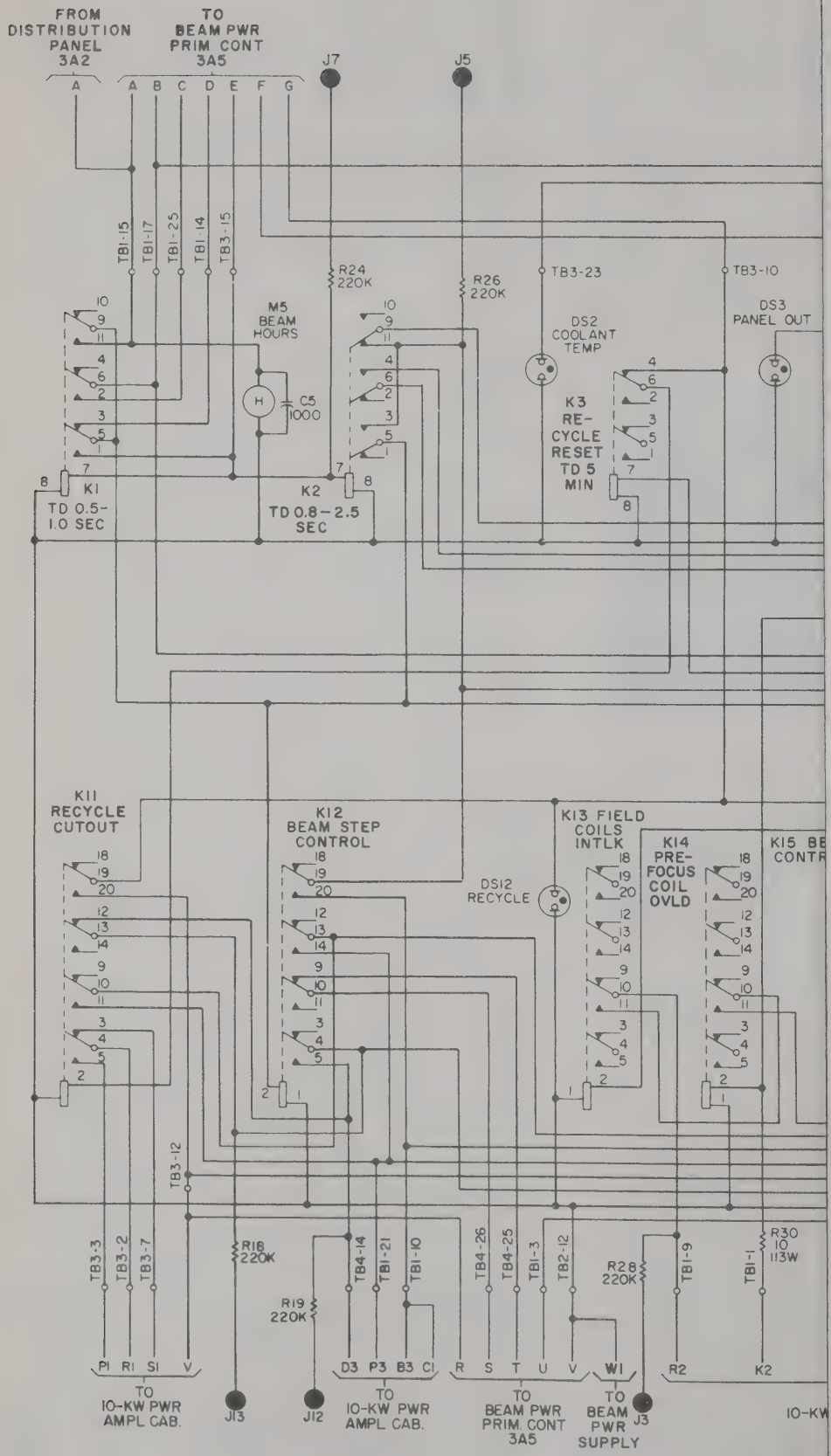
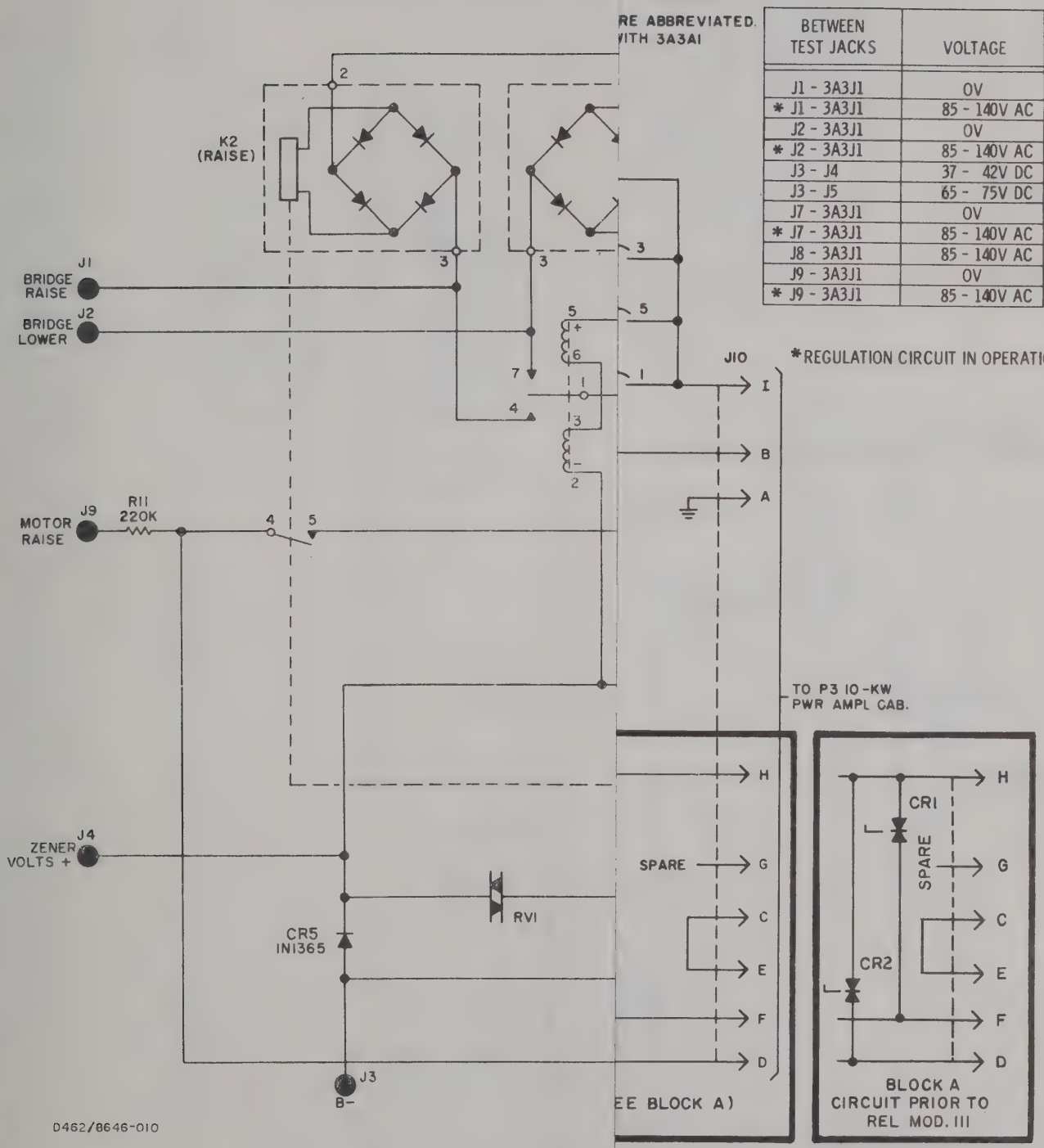
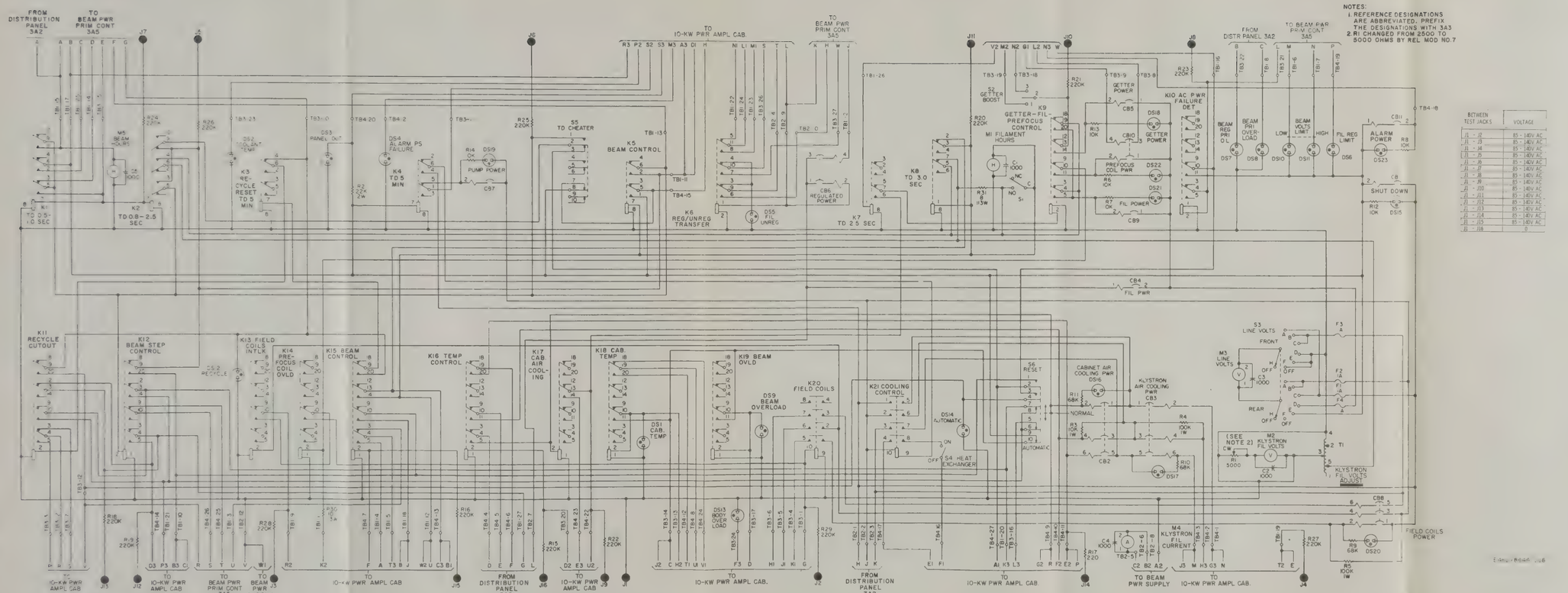
Figure 6-6.1. AC Control Panel (After REL Mod. No. 50). Schematic Diagram

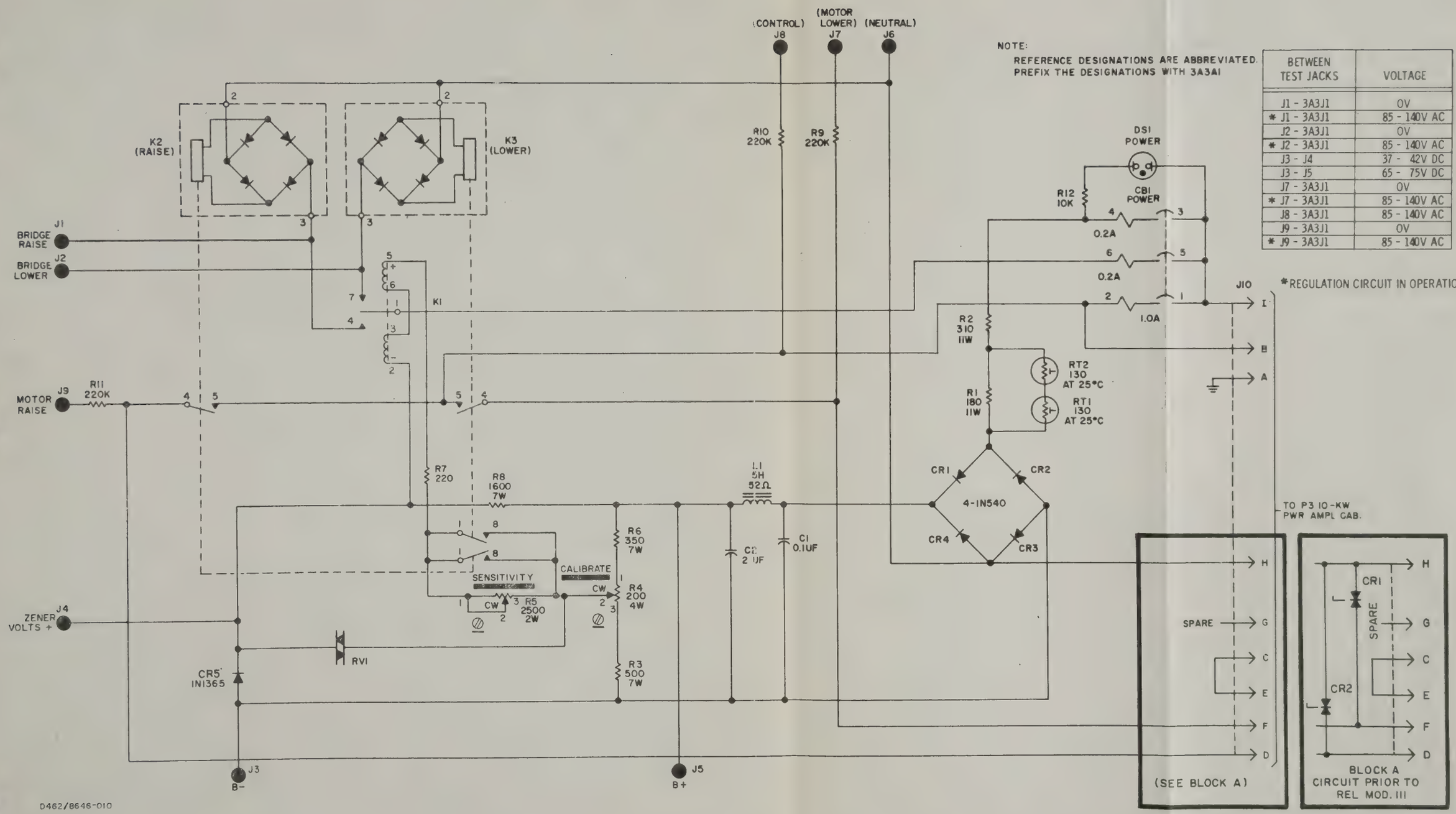

FROM DISTRIBUTION PANEL 3A2
TO BEAM PWR PRIM CONT 3A5
A B C D E F G
J7
J5
TB1-15
TB1-17
TB1-25
TB1-14
TB3-15
R24 220K
R26 220K
TB3-23
TB3-10
M5 BEAM HOURS
C5 1000
DS2 COOLANT TEMP
DS3 PANEL OUT
K3 RE-CYCLE RESET TD 5 MIN
K1 TD 0.5-1.0 SEC
K2 TD 0.8-2.5 SEC
K11 RECYCLE CUTOUT
K12 BEAM STEP CONTROL
K13 FIELD COILS INTLK
K14 PRE-FOCUS COIL OVLD
K15 BE CONTR
DS12 RECYCLE
TB3-12
TB3-3
TB3-2
TB3-7
R18 220K
R19 220K
TB4-14
TB1-21
TB1-10
TB4-26
TB4-25
TB1-3
TB2-12
R28 220K
TB1-9
TB1-1
R30 10 113W
P1 R1 S1 V
D3 P3 B3 C1
R S T U V
W1
R2
K2
TO 10-KW PWR AMPL CAB.
J13
J12
TO 10-KW PWR AMPL CAB.
TO BEAM PWR PRIM. CONT 3A5
TO BEAM PWR SUPPLY
J3
10-KW



BETWEEN TEST JACKS	VOLTAGE
J1 - 3A3J1	OV
* J1 - 3A3J1	85 - 140V AC
J2 - 3A3J1	OV
* J2 - 3A3J1	85 - 140V AC
J3 - J4	37 - 42V DC
J3 - J5	65 - 75V DC
J7 - 3A3J1	OV
* J7 - 3A3J1	85 - 140V AC
J8 - 3A3J1	85 - 140V AC
J9 - 3A3J1	OV
* J9 - 3A3J1	85 - 140V AC

*REGULATION CIRCUIT IN OPERATION.


NOTES:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A5
2. R1 CHANGED FROM 2500 TO 5000 OHMS BY REL MOD NO. 7
BETWEEN TEST JACKS
VOLTAGE
J1 - J2
85 - 140V AC
J1 - J3
85 - 140V AC
J1 - J4
85 - 140V AC
J1 - J5
85 - 140V AC
J1 - J6
85 - 140V AC
J1 - J7
85 - 140V AC
J1 - J8
85 - 140V AC
J1 - J9
85 - 140V AC
J1 - J10
85 - 140V AC
J1 - J11
85 - 140V AC
J1 - J12
85 - 140V AC
J1 - J13
85 - 140V AC
J1 - J14
85 - 140V AC
J1 - J15
85 - 140V AC
J1 - J16
0
FROM DISTRIBUTION PANEL 3A2
TO BEAM PWR PRIM CONT 3A5
TO 10-KW PWR AMPL CAB.
TO BEAM PWR PRIM CONT 3A5
FROM DISTR PANEL 3A2
TO BEAM PWR PRIM CONT 3A5
K1 RECYCLE CUTOUT
K2 BEAM STEP CONTROL
K3 FIELD COILS INTLK
K4 PRE-FOCUS COIL OVLD
K5 BEAM CONTROL
K6 TEMP CONTROL
K7 CAB. AIR COOLING
K8 CAB. TEMP
K9 BEAM OVLD
K20 FIELD COILS
K21 COOLING CONTROL
S1 HEAT EXCHANGER
S2 GETTER BOOST
S3 LINE VOLTS
S4 AUTOMATIC
S5 TD CHEATER
S6 RESET
M1 FILAMENT HOURS
M2 KLYSTRON FIL VOLTS
M3 LINE VOLTS
M4 KLYSTRON FIL CURRENT
M5 BEAM CURR
K1 TD 0.8 - 2.5 SEC
K2 TD 0.5 - 10 SEC
K3 RE-CYCLE RESET TD 5 MIN
K4 TD 5 MIN
K5 BEAM CONTROL
K6 REG/UNREG TRANSFER
K7 TD 2.5 SEC
K8 TD 3.0 SEC
K9 GETTER-FIL-PREFOCUS CONTROL
K10 AC PWR FAILURE DET
DS1 CAB. TEMP
DS2 RECYCLE
DS3 PANEL OUT
DS4 ALARM PS FAILURE
DS5 FIL UNREG
DS6 PUMP POWER
DS7 BEAM REG PRI OL
DS8 BEAM PRI OVERLOAD
DS9 BEAM OVERLOAD
DS10 BODY OVER LOAD
DS11 BEAM VOLTS LIMIT
DS12 PREFOCUS COIL PWR
DS13 GETTER POWER
DS14 AUTOMATIC
DS15 SHUT DOWN
DS16 CABINET AIR COOLING PWR
DS17 KLYSTRON AIR COOLING PWR
DS18 GETTER POWER
DS19 FIL REG LIMIT
DS20 ALARM POWER
DS21 FIL POWER
DS22 PREFOCUS COIL PWR
DS23 ALARM POWER
CB1 FIL PWR
CB2 FIL POWER
CB3 KLYSTRON AIR COOLING PWR
CB4 FIL PWR
CB5 GETTER POWER
CB6 PREFOCUS COIL PWR
CB7 FIL POWER
CB8 ALARM POWER
CB9 FIL POWER
CB10 GETTER POWER
CB11 ALARM POWER
CB12 FIL POWER
CB13 FIELD COILS POWER
CB14 FIELD COILS POWER
CB15 FIELD COILS POWER
CB16 FIELD COILS POWER
CB17 FIELD COILS POWER
CB18 FIELD COILS POWER
CB19 FIELD COILS POWER
CB20 FIELD COILS POWER
CB21 FIELD COILS POWER
CB22 FIELD COILS POWER

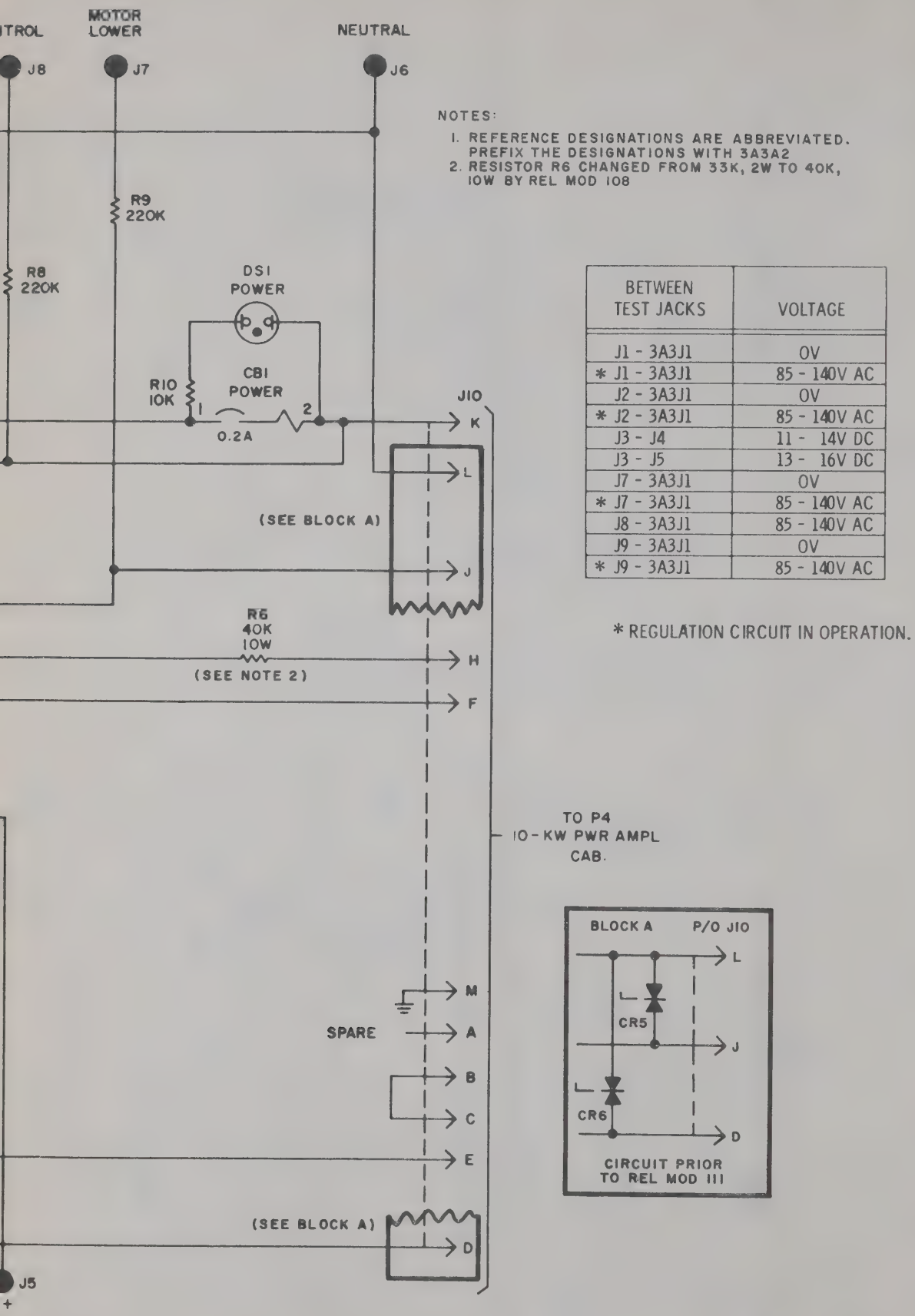


NOTE:
REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A3A1

BETWEEN TEST JACKS	VOLTAGE
J1 - 3A3J1	0V
* J1 - 3A3J1	85 - 140V AC
J2 - 3A3J1	0V
* J2 - 3A3J1	85 - 140V AC
J3 - J4	37 - 42V DC
J3 - J5	65 - 75V DC
J7 - 3A3J1	0V
* J7 - 3A3J1	85 - 140V AC
J8 - 3A3J1	85 - 140V AC
J9 - 3A3J1	0V
* J9 - 3A3J1	85 - 140V AC

*REGULATION CIRCUIT IN OPERATION.

Figure 6-7. 120-Volt Regulator Control Panel 3A3A1, Schematic Diagram



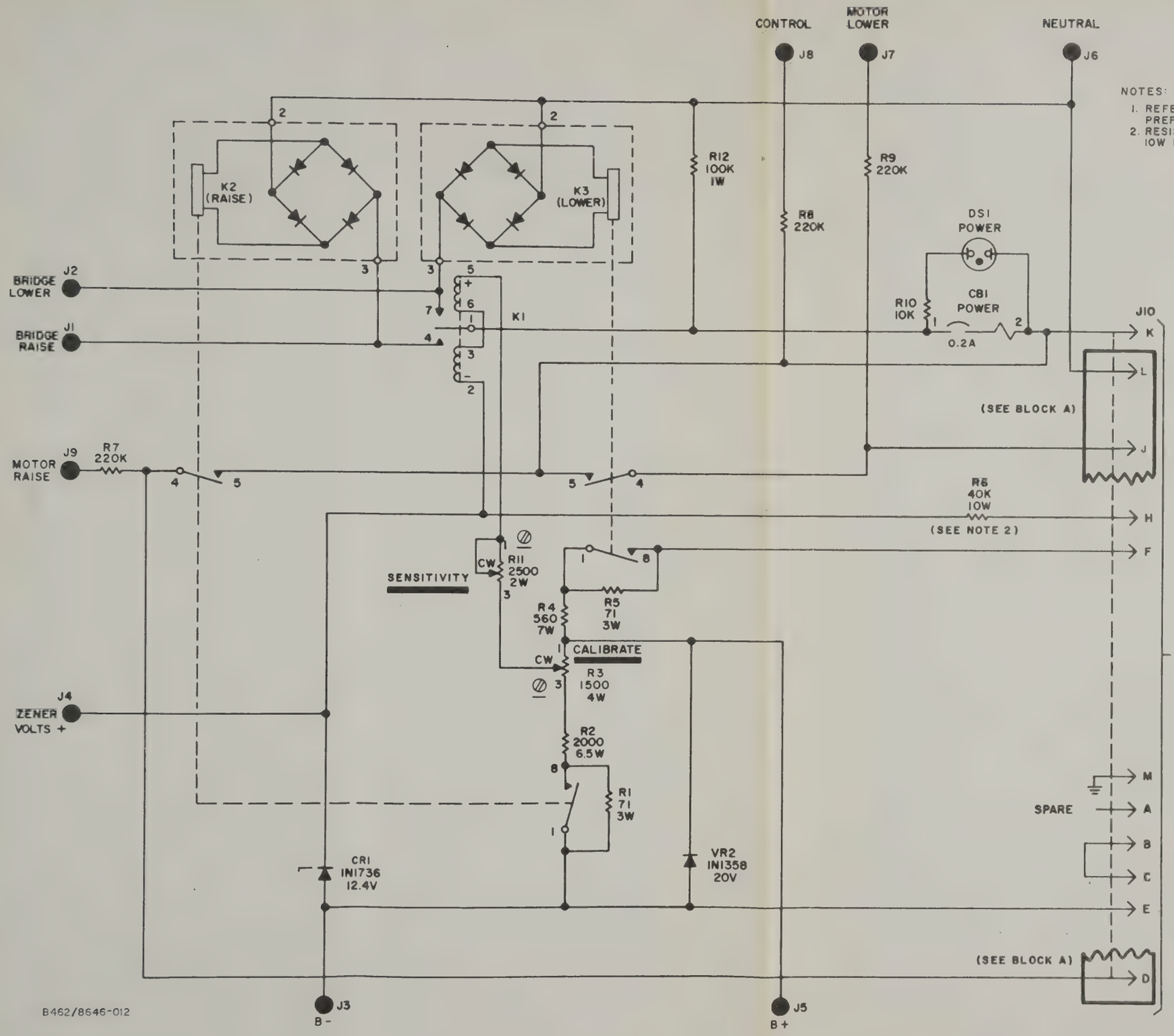
BETWEEN TEST JACKS	VOLTAGE
J1 - 3A3J1	0V
* J1 - 3A3J1	85 - 140V AC
J2 - 3A3J1	0V
* J2 - 3A3J1	85 - 140V AC
J3 - J4	11 - 14V DC
J3 - J5	13 - 16V DC
J7 - 3A3J1	0V
* J7 - 3A3J1	85 - 140V AC
J8 - 3A3J1	85 - 140V AC
J9 - 3A3J1	0V
* J9 - 3A3J1	85 - 140V AC

* REGULATION CIRCUIT IN OPERATION.

igure 6-8. Field Coils Regulator Control Panel 3A3A2, Schematic Diagram

TM 11-5820-757-15

Figure 6-9. Alarm Panel 3A3A3, Schematic Diagram



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A3A2
2. RESISTOR R6 CHANGED FROM 33K, 2W TO 40K, 10W BY REL MOD 108

BETWEEN TEST JACKS	VOLTAGE
J1 - 3A3J1	0V
* J1 - 3A3J1	85 - 140V AC
J2 - 3A3J1	0V
* J2 - 3A3J1	85 - 140V AC
J3 - J4	11 - 14V DC
J3 - J5	13 - 16V DC
J7 - 3A3J1	0V
* J7 - 3A3J1	85 - 140V AC
J8 - 3A3J1	85 - 140V AC
J9 - 3A3J1	0V
* J9 - 3A3J1	85 - 140V AC

* REGULATION CIRCUIT IN OPERATION.

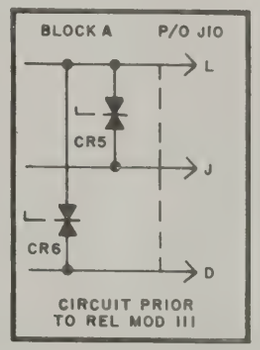
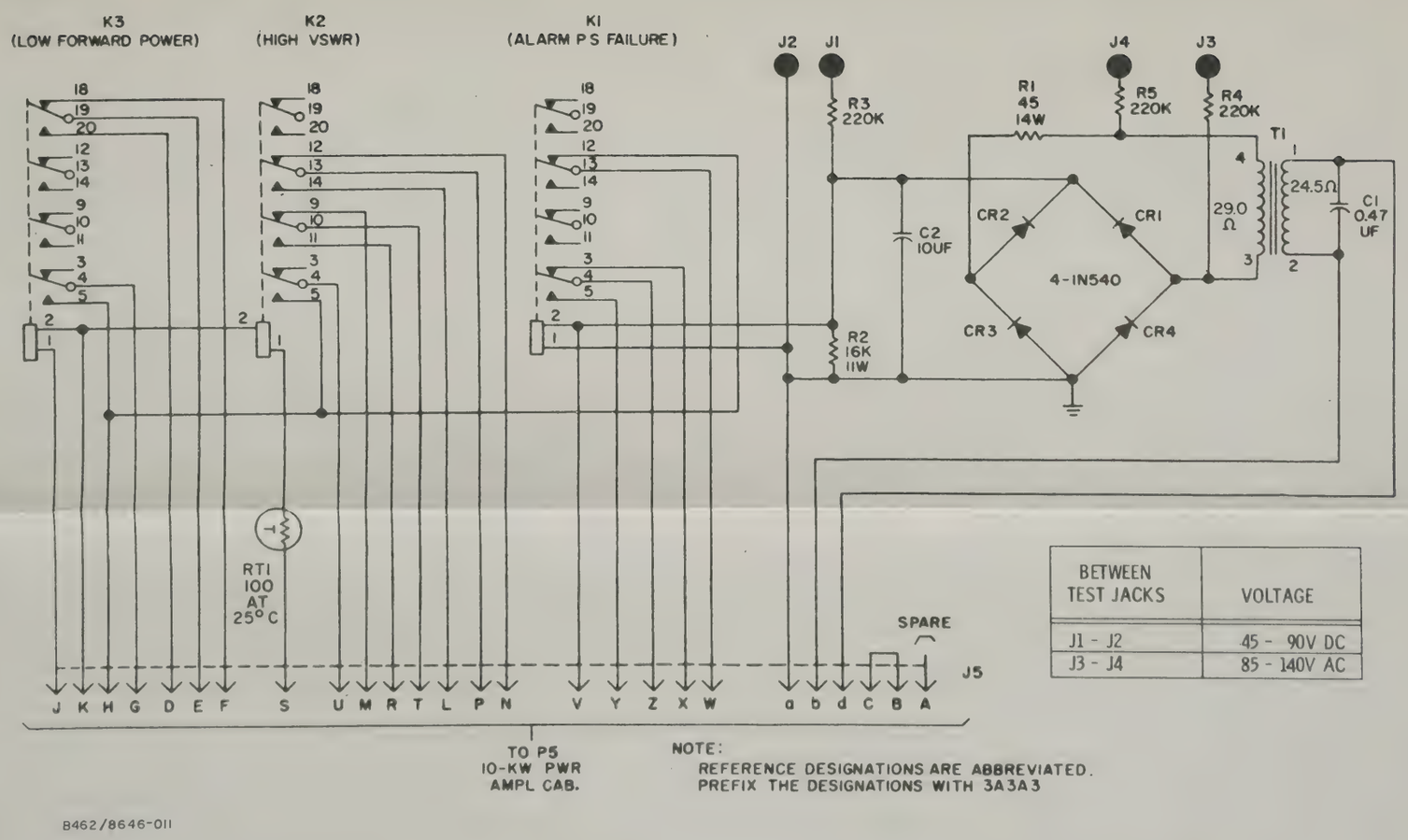


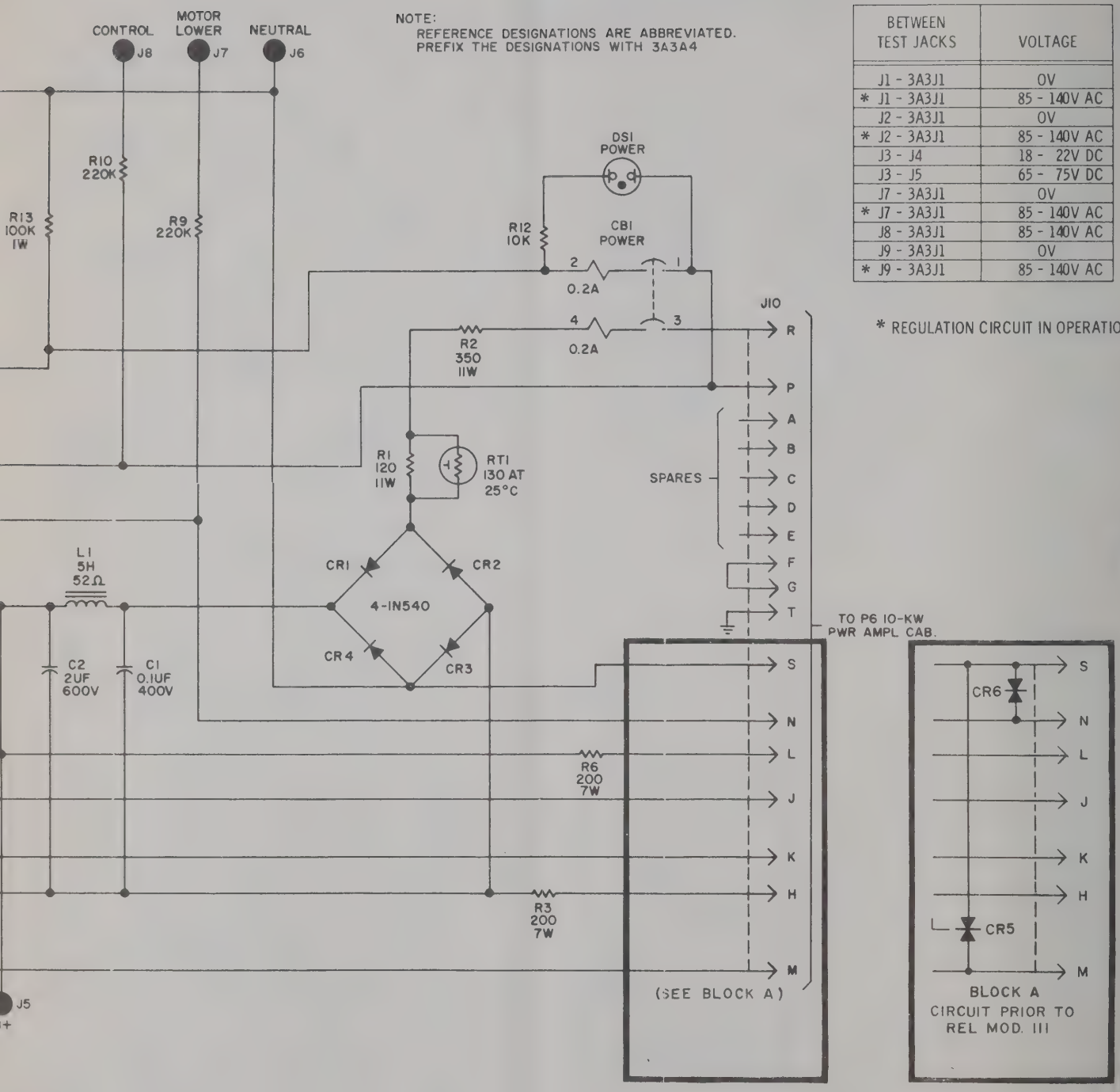
Figure 6-8. Field Coils Regulator Control Panel 3A3A2, Schematic Diagram



BETWEEN TEST JACKS	VOLTAGE
J1 - J2	45 - 90V DC
J3 - J4	85 - 140V AC

Figure 6-9. Alarm Panel 3A3A3, Schematic Diagram

TM 11-5820-757-15



BETWEEN TEST JACKS	VOLTAGE
J1 - 3A3J1	0V
* J1 - 3A3J1	85 - 140V AC
J2 - 3A3J1	0V
* J2 - 3A3J1	85 - 140V AC
J3 - J4	18 - 22V DC
J3 - J5	65 - 75V DC
J7 - 3A3J1	0V
* J7 - 3A3J1	85 - 140V AC
J8 - 3A3J1	85 - 140V AC
J9 - 3A3J1	0V
* J9 - 3A3J1	85 - 140V AC

* REGULATION CIRCUIT IN OPERATION.

Figure 6-10. Beam Regulator Panel 3A3A4, Schematic Diagram

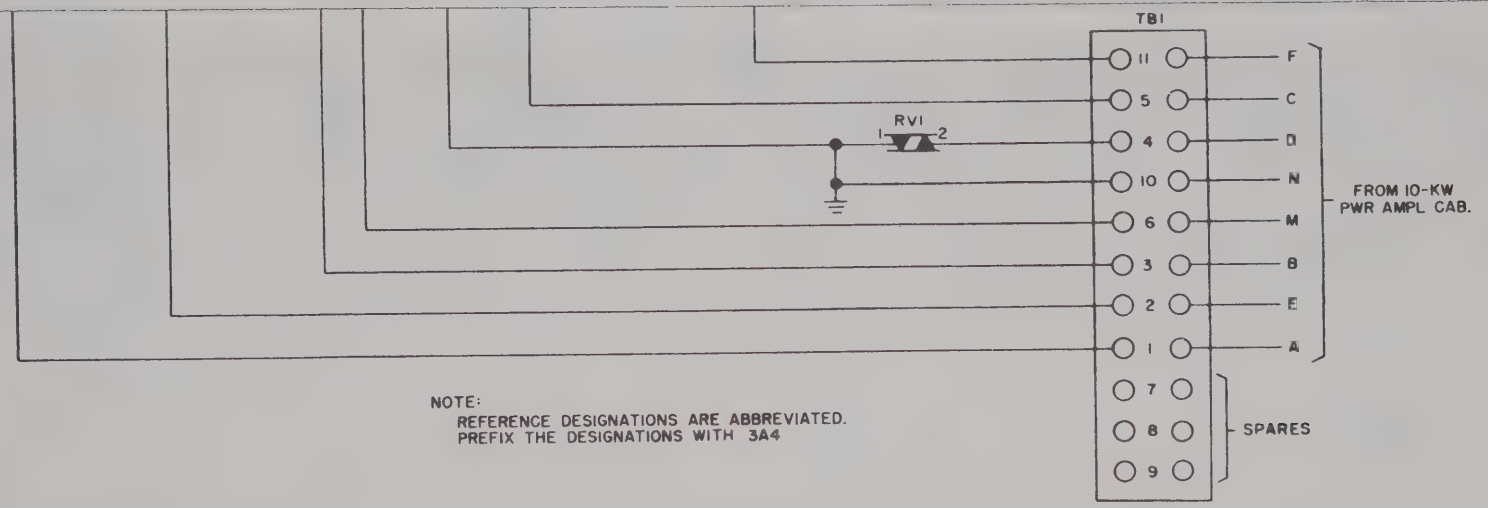


Figure 6-11. Meter Panel 3A4, Schematic Diagram

BETWEEN TEST JACKS	VOLTAGE
J1 - 3A3J1	OV
* J1 - 3A3J1	85 - 140V AC
J2 - 3A3J1	OV
* J2 - 3A3J1	85 - 140V AC
J3 - J4	18 - 22V DC
J3 - J5	65 - 75V DC
J7 - 3A3J1	OV
* J7 - 3A3J1	85 - 140V AC
J8 - 3A3J1	85 - 140V AC
J9 - 3A3J1	OV
* J9 - 3A3J1	85 - 140V AC

* REGULATION CIRCUIT IN OPERATION.

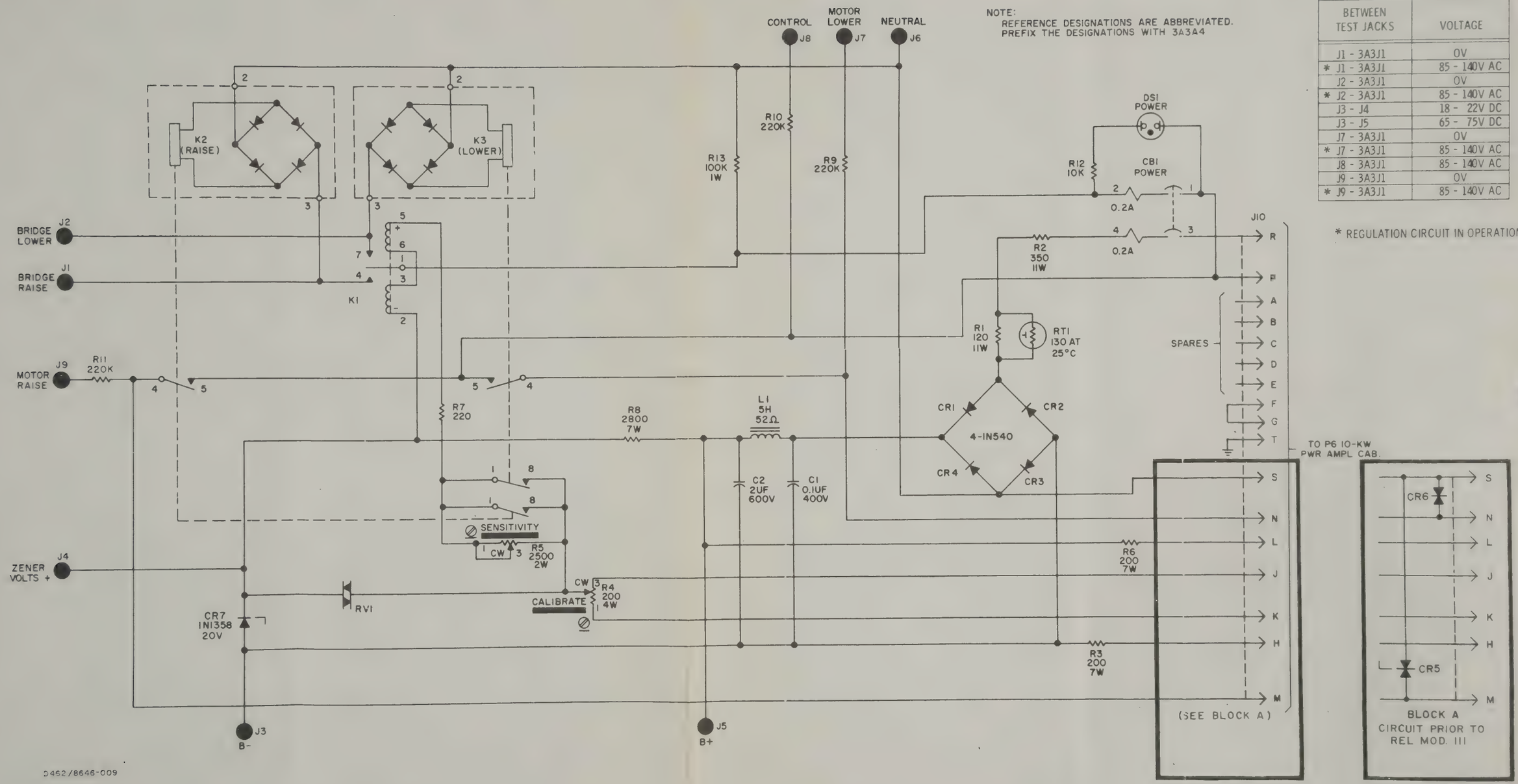


Figure 6-10. Beam Regulator Panel 3A3A4, Schematic Diagram

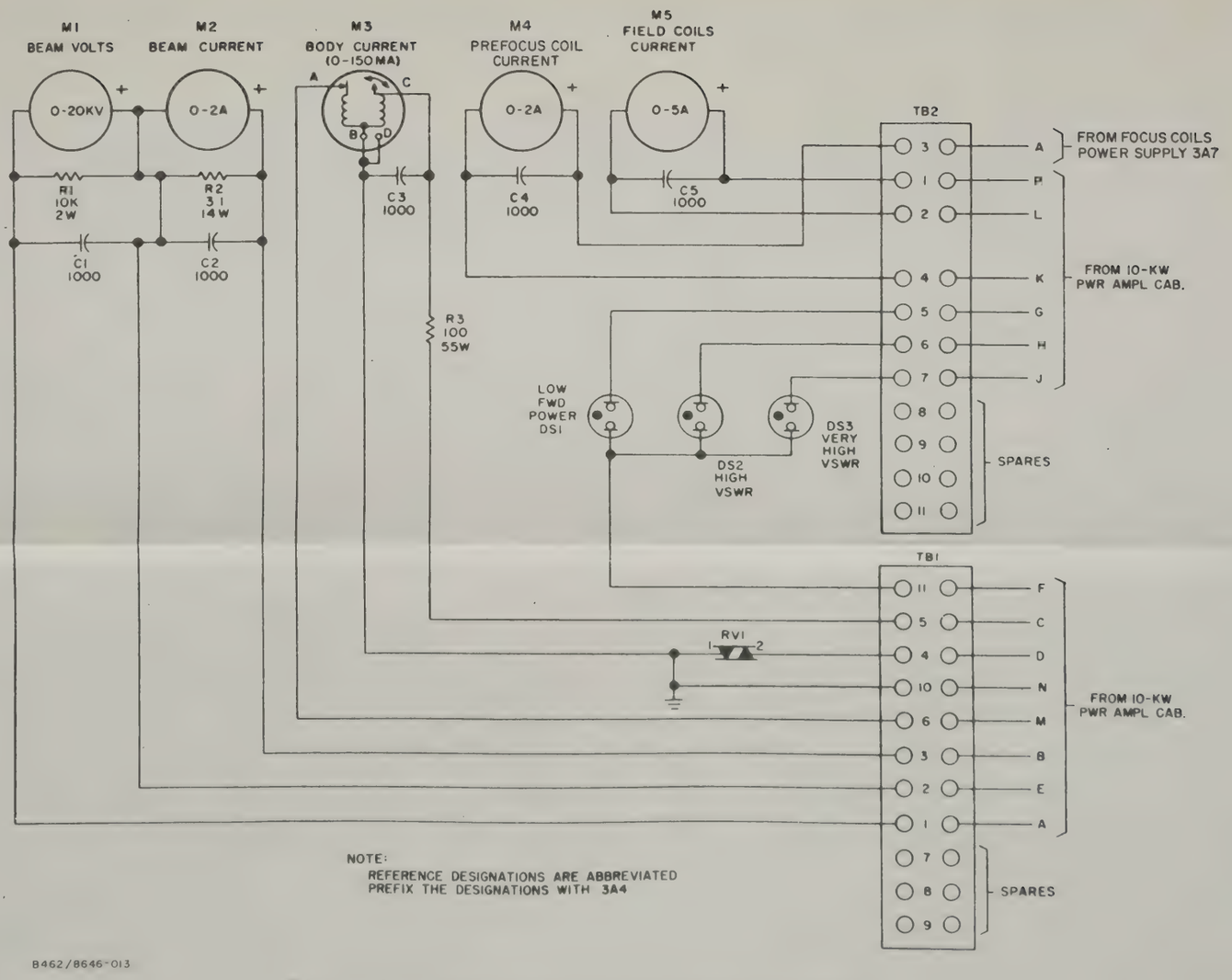


Figure 6-11. Meter Panel 3A4, Schematic Diagram

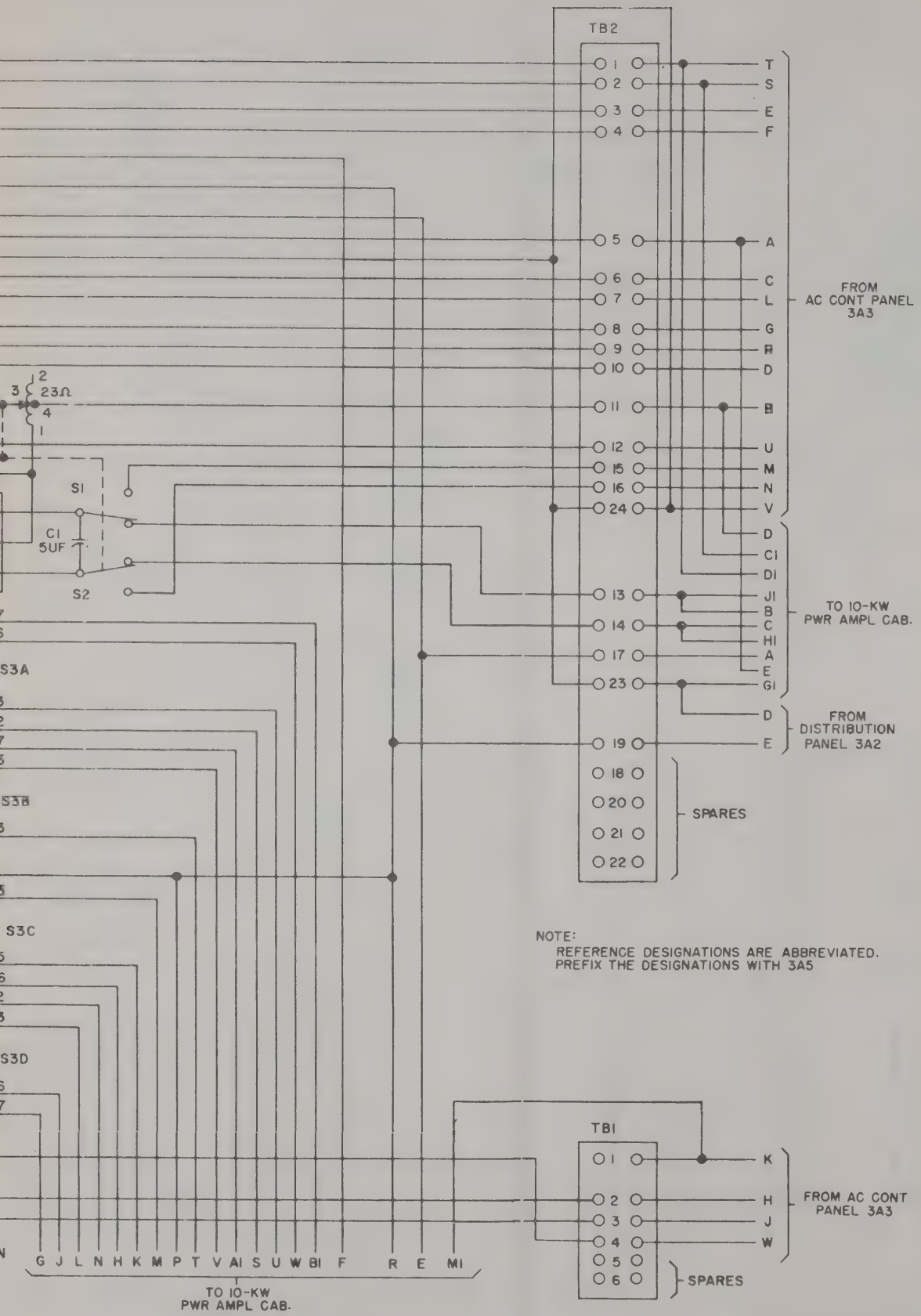


Figure 6-12. Beam Power Primary Control 3A5, Schematic Diagram

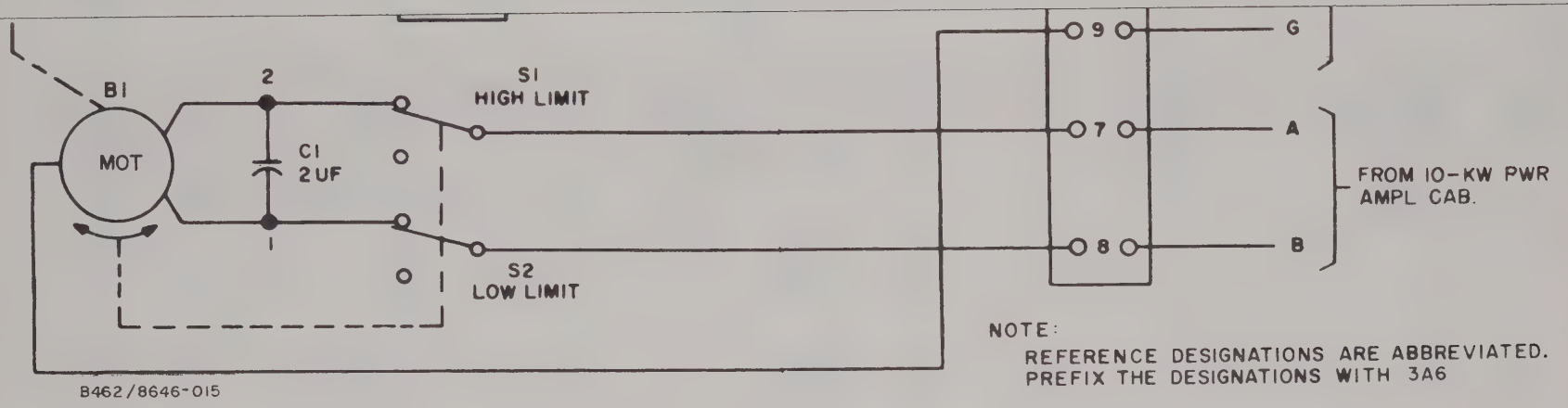


Figure 6-13. Field Coils Variable Autotransformer 3A6, Schematic Diagram

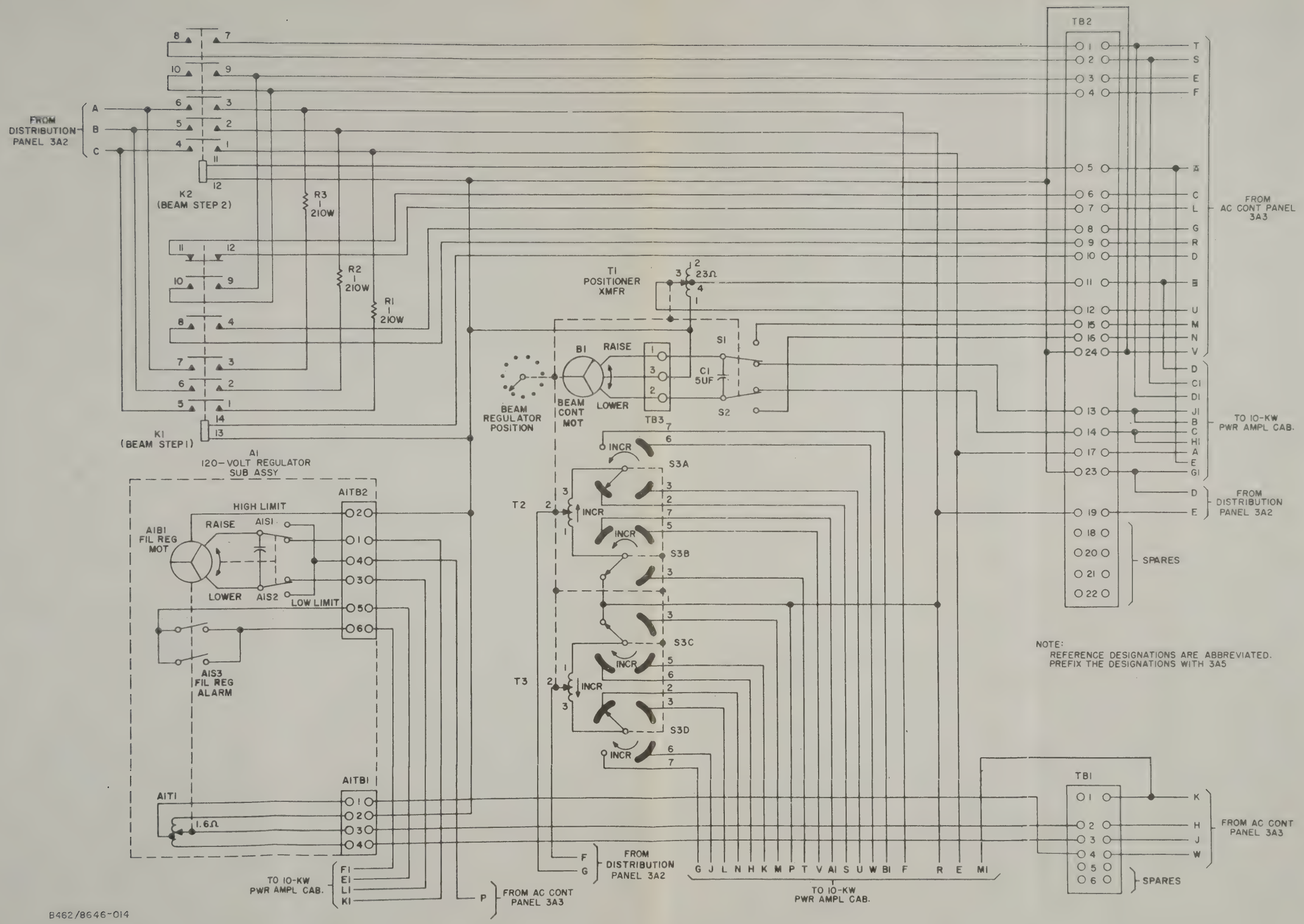


Figure 6-12. Beam Power Primary Control 3A5, Schematic Diagram

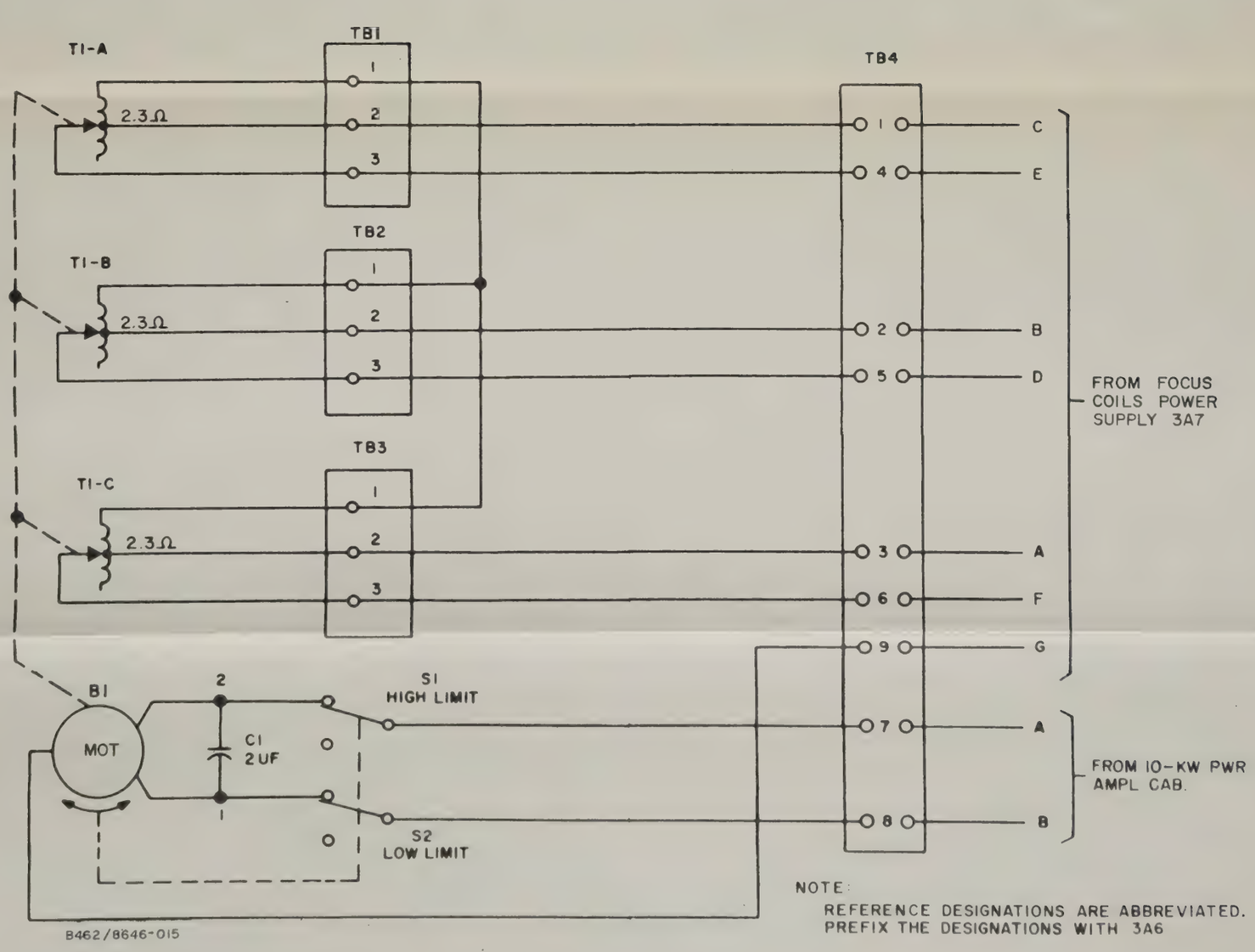
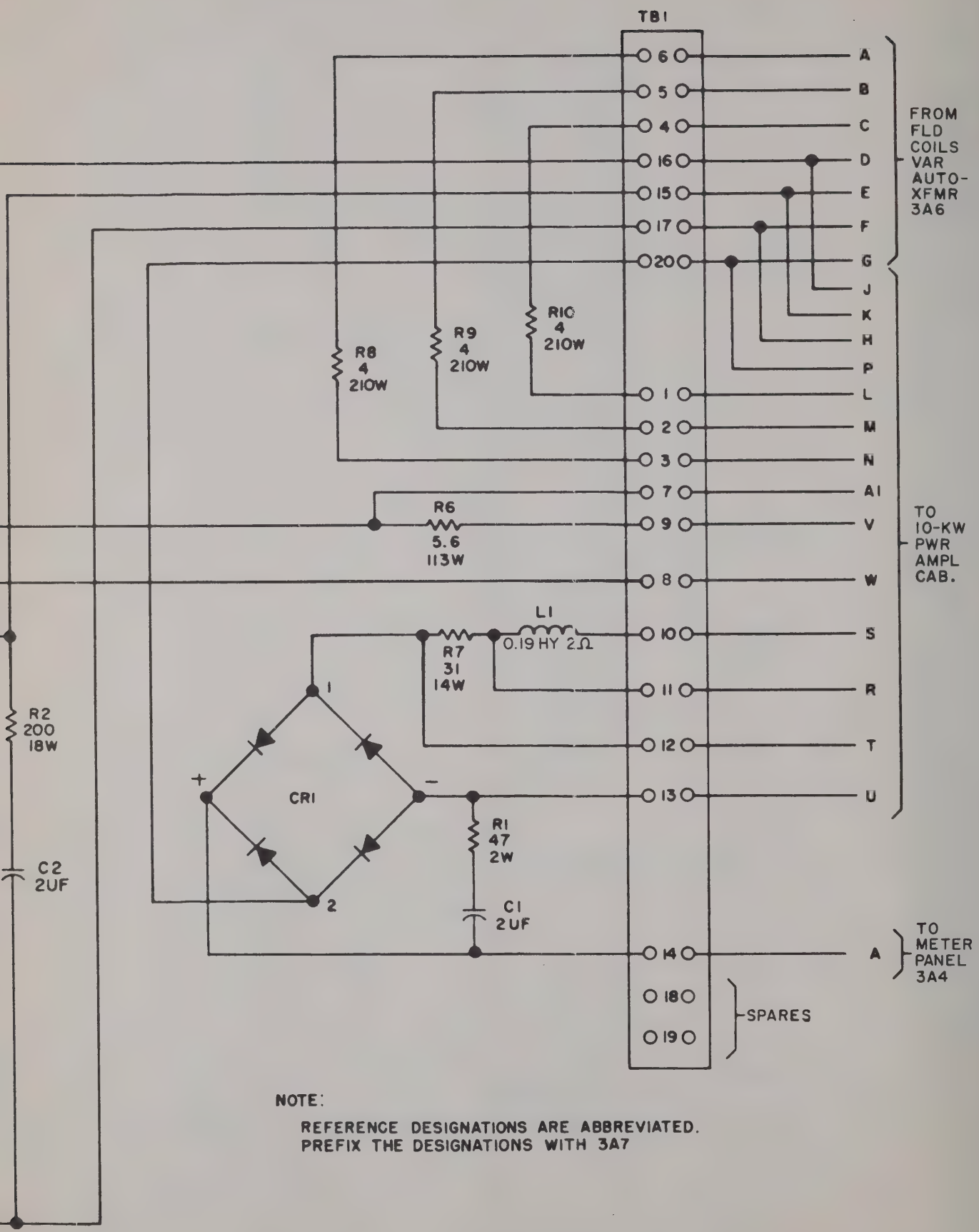


Figure 6-13. Field Coils Variable Autotransformer 3A6, Schematic Diagram



NOTE:

REFERENCE DESIGNATIONS ARE ABBREVIATED.
PREFIX THE DESIGNATIONS WITH 3A7

Figure 6-14. Foucs Coils Power Supply 3A7, Schematic Diagram

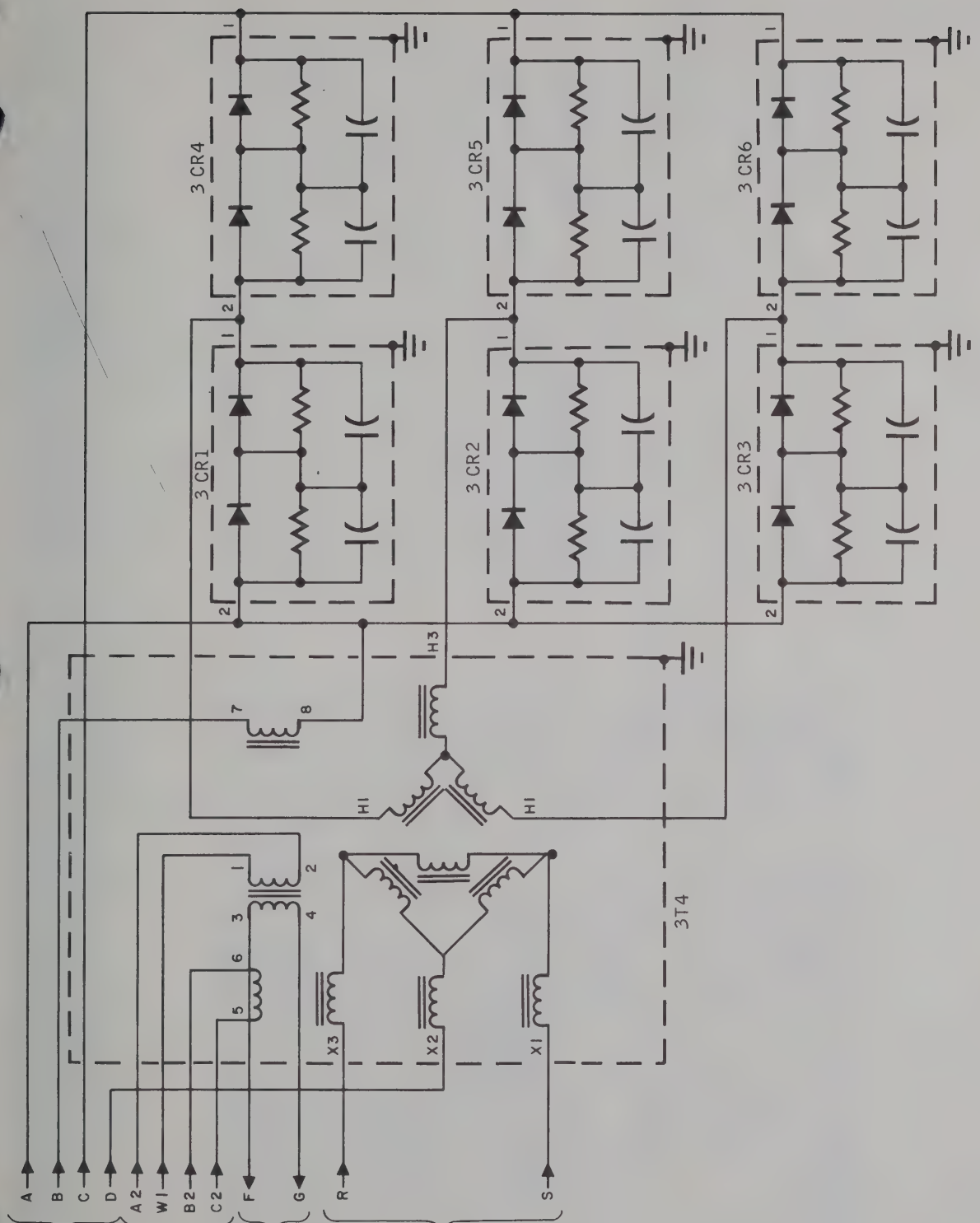
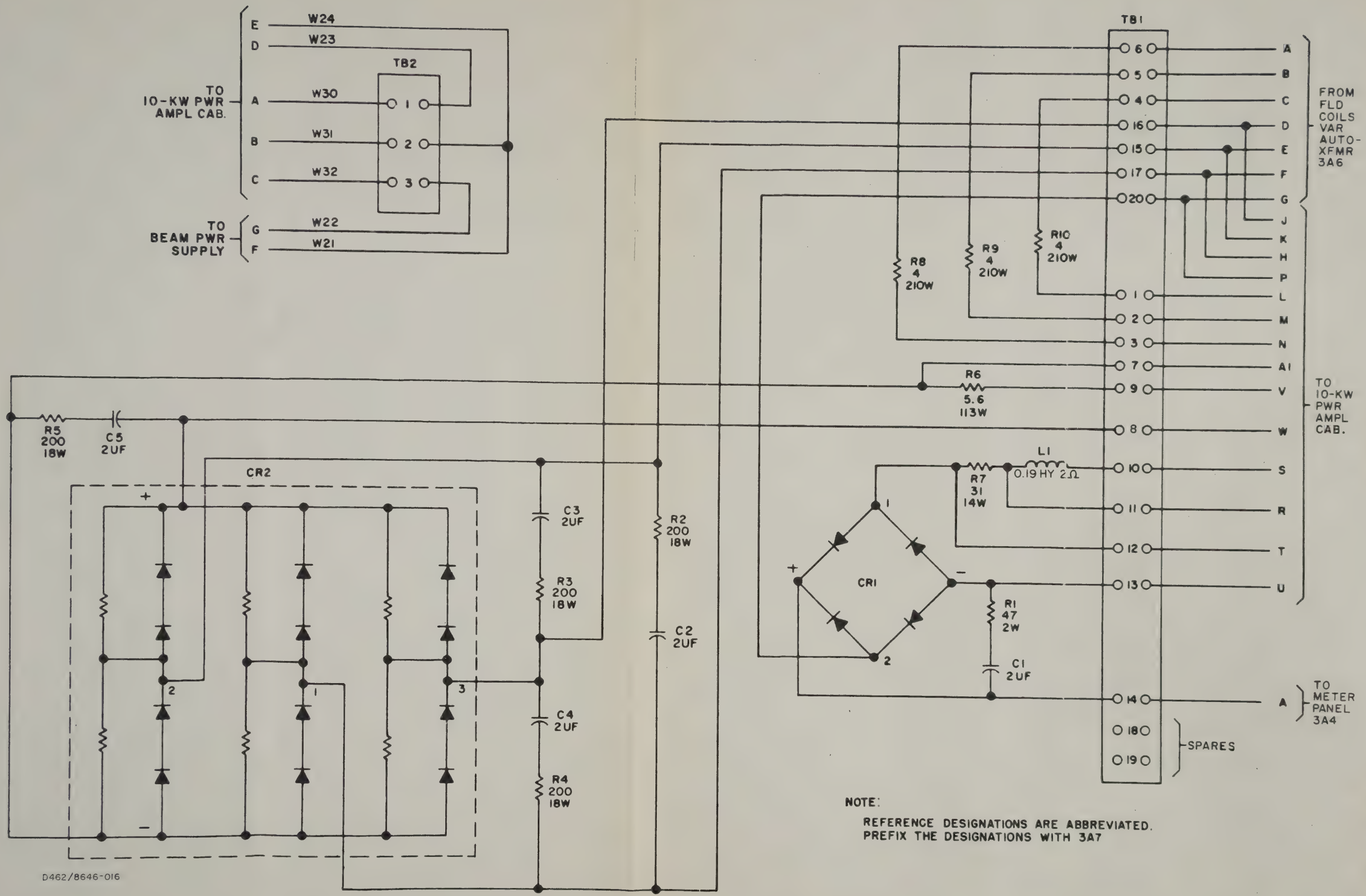


Figure 6-15. Beam Power Supply, Schematic Diagram



NOTE:

REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH 3A7

Figure 6-14. Foucs Coils Power Supply 3A7, Schematic Diagram

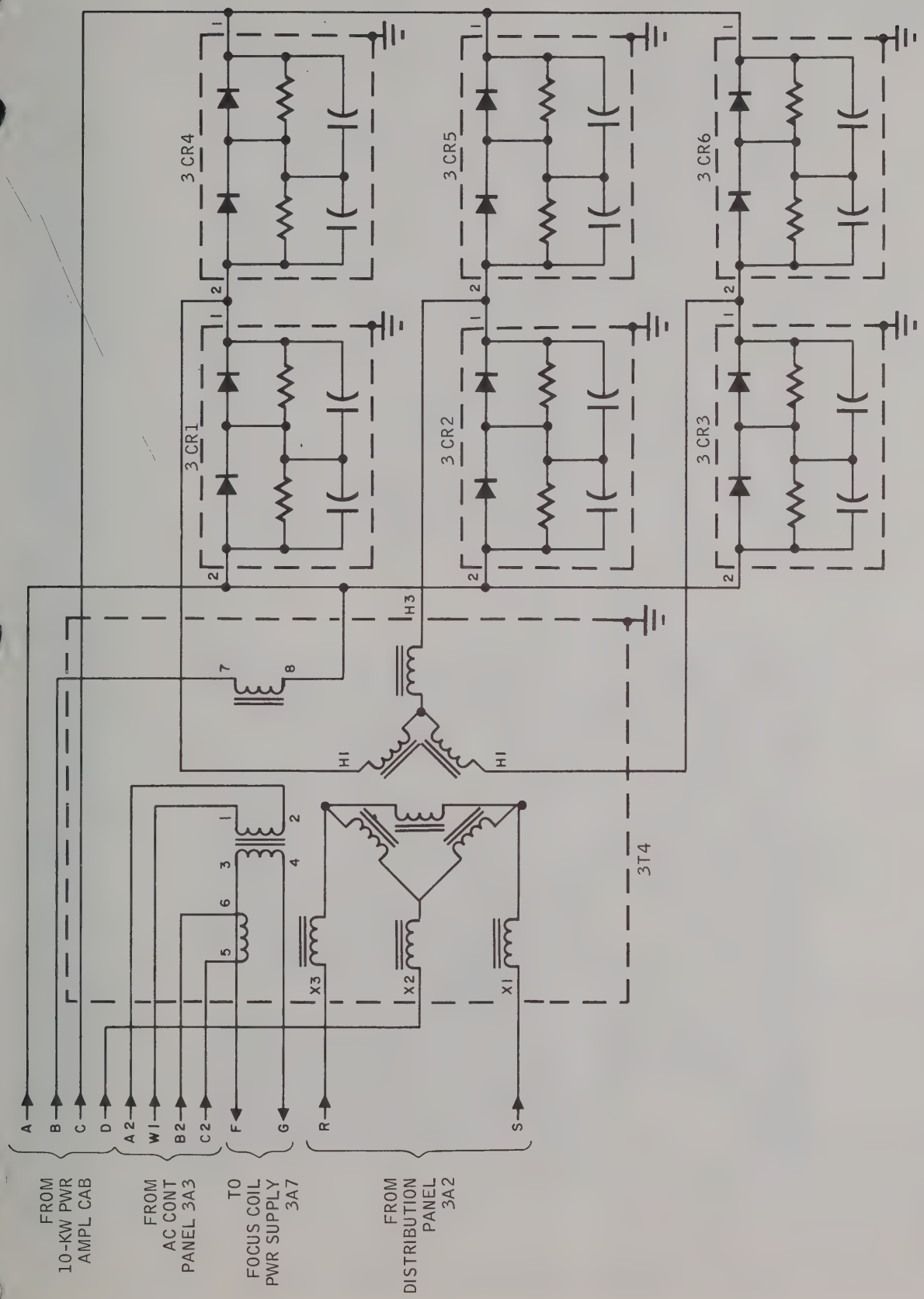


Figure 6-15. Beam Power Supply, Schematic Diagram

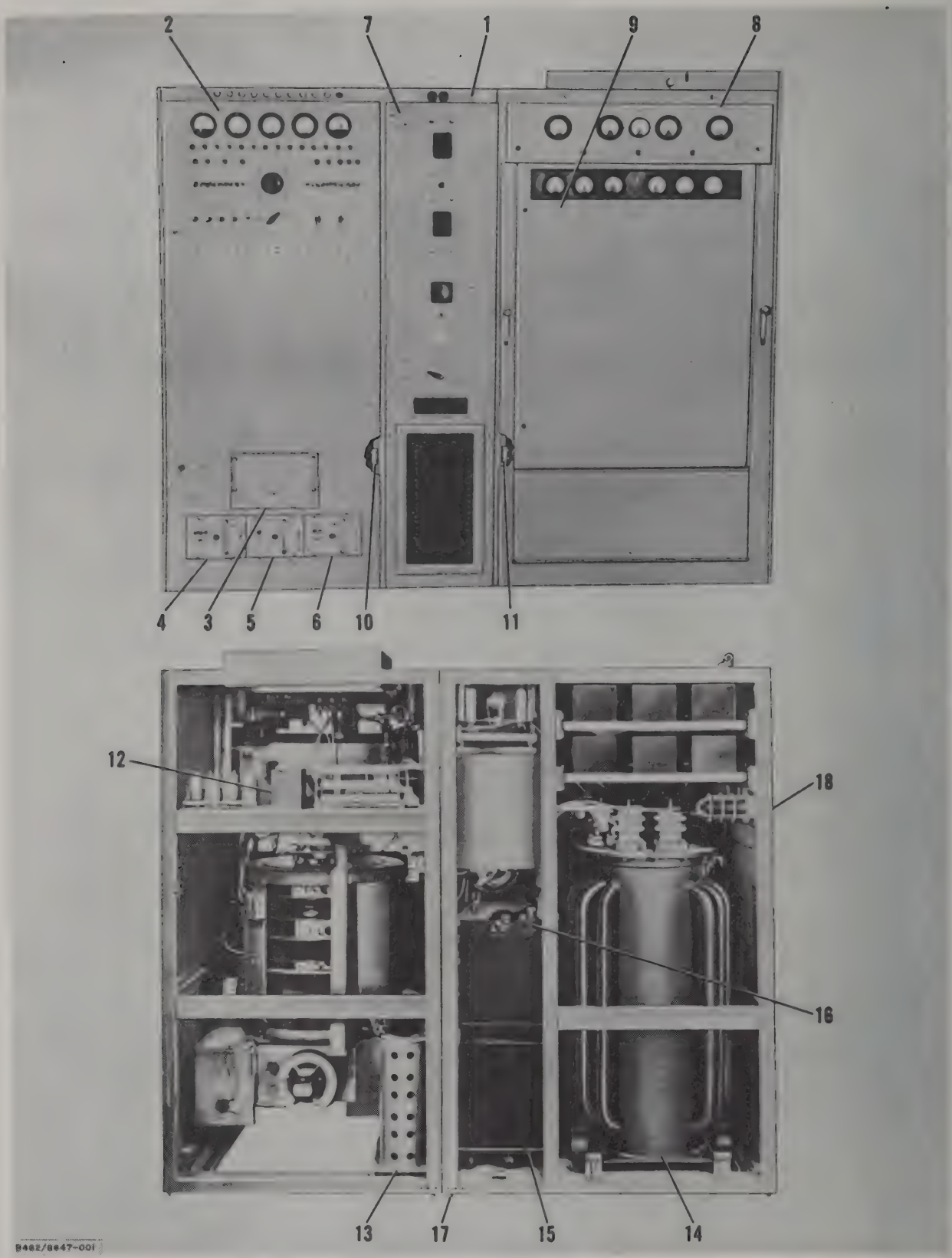


Figure 6-16. Amplifier-Power Supply Group OA-2973/FRC-39A(V) and OA-4408/MRC-98

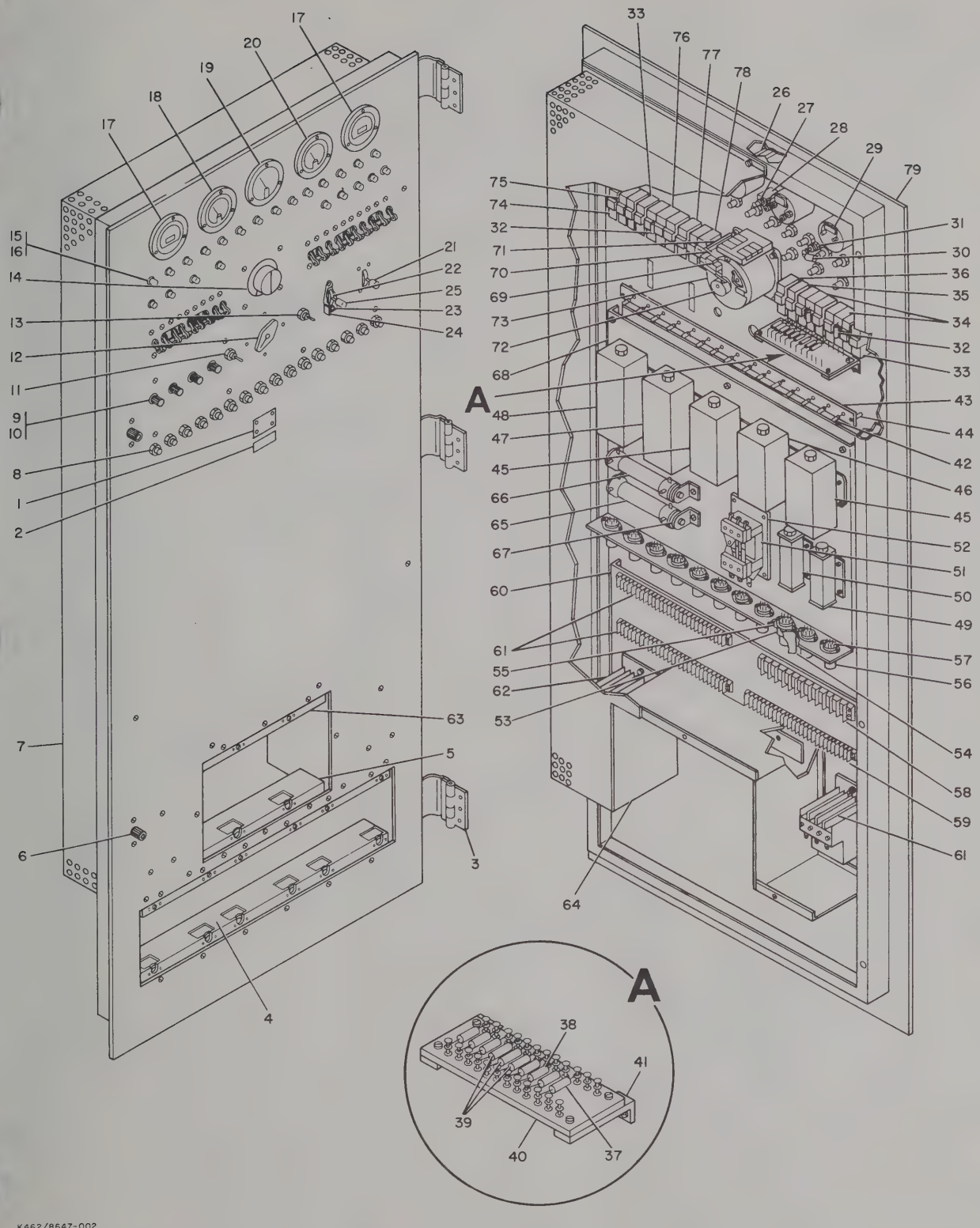


Figure 6-17. Power Distribution Panel SB-1193/FRC-39A(V)

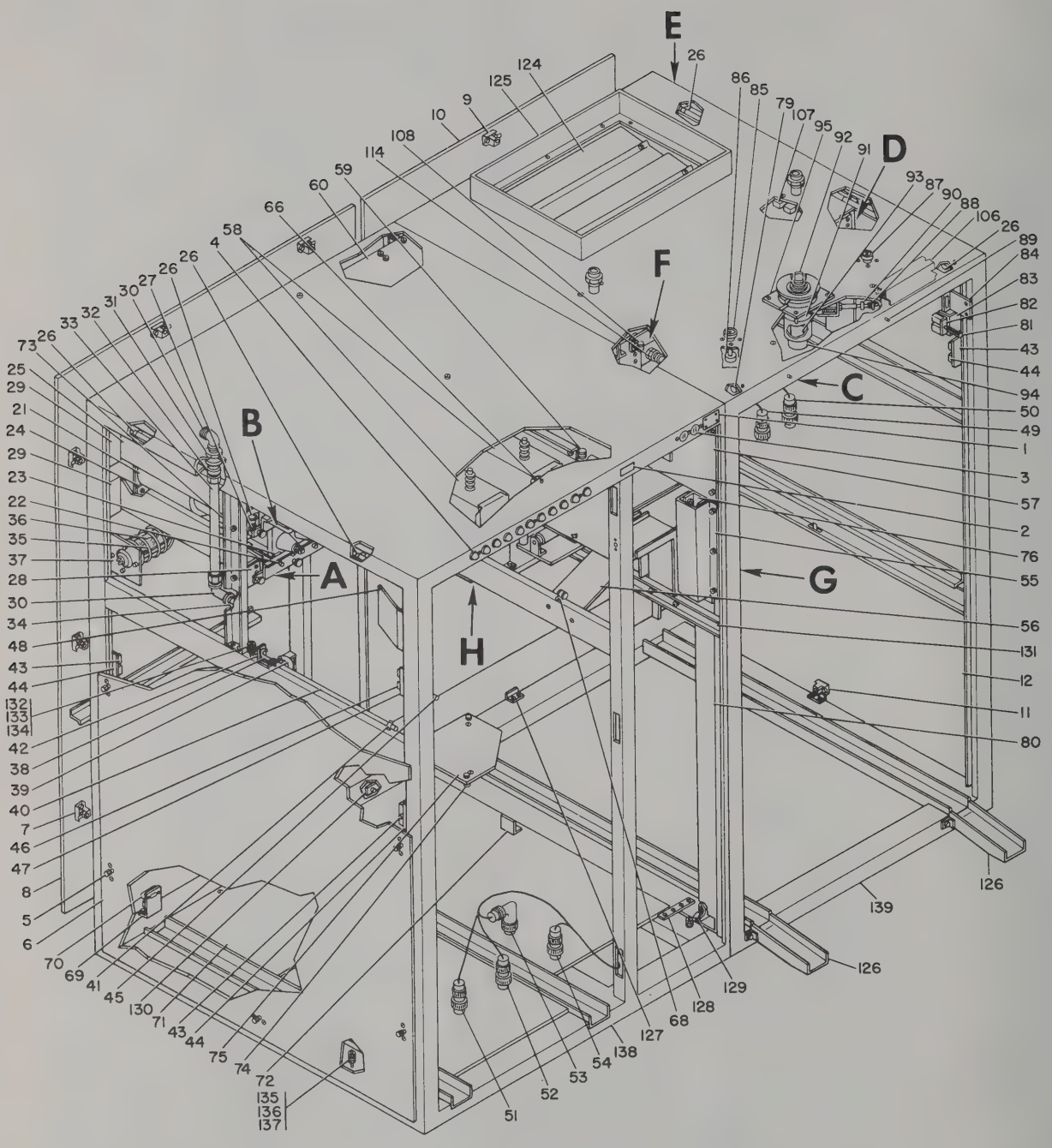


Figure 6-18 Electrical Equipment Cabinet CY-2981/FRC-39A(V) and CY-3794/MRC-98 (Sheet 1 of 2)

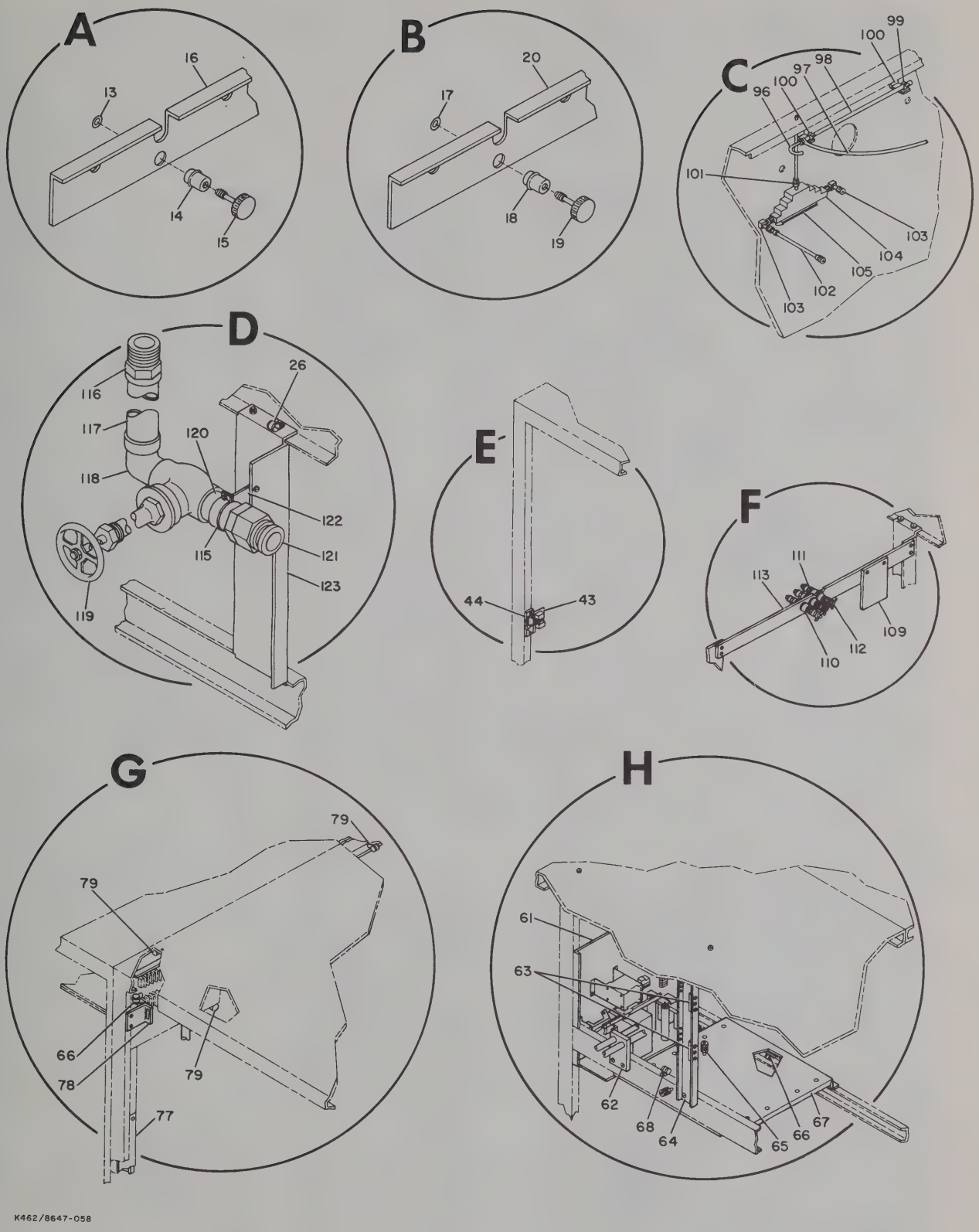


Figure 6-18. Electrical Equipment Cabinet CY-2981/FRC-39A(V) and CY-3794/MRC-98 (Sheet 2 of 2)

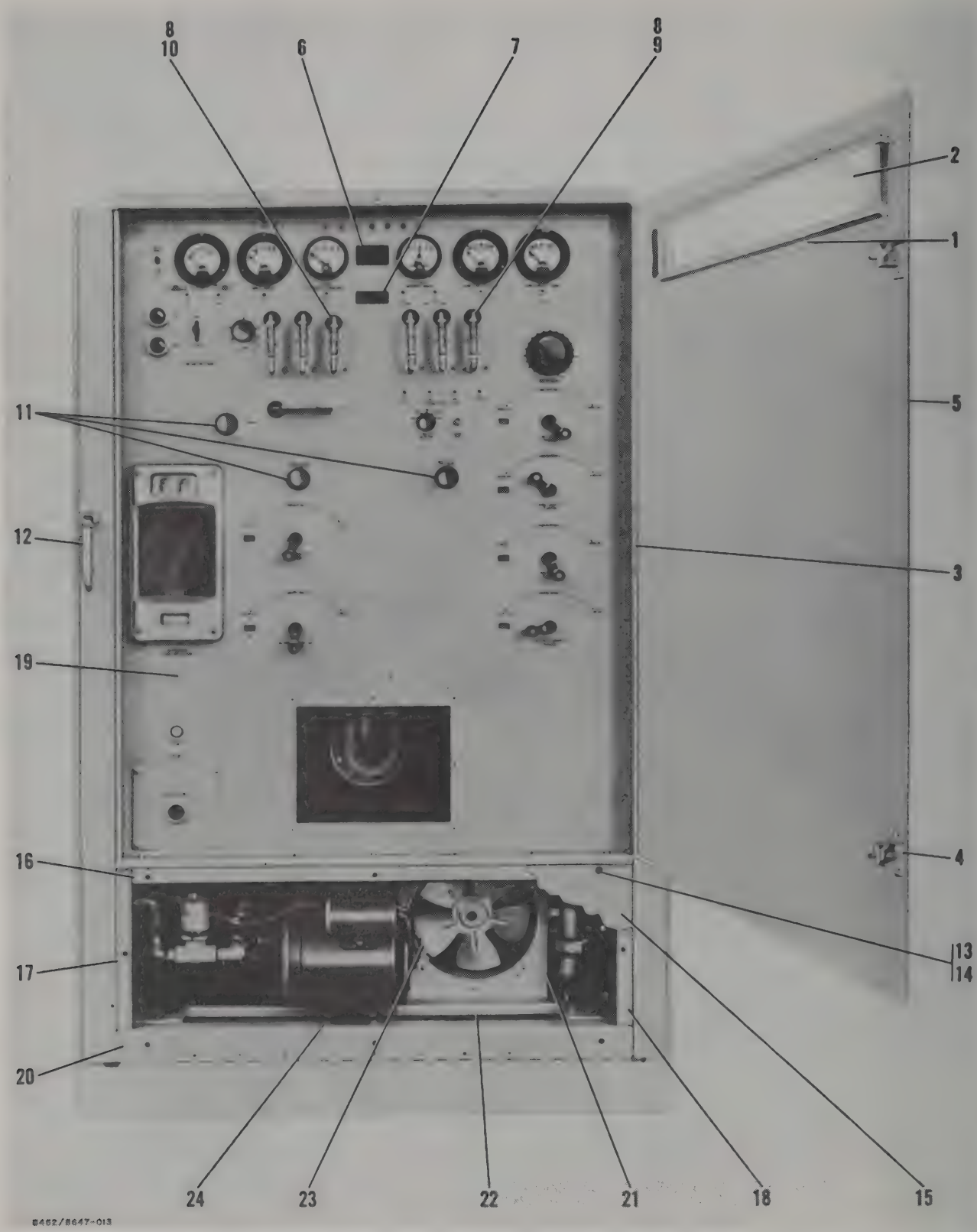


Figure 6-19. Radio Frequency Amplifier AM-2752/FRC-39A(V) and AM-3629/MRC-98 (Sheet 1 of 5)

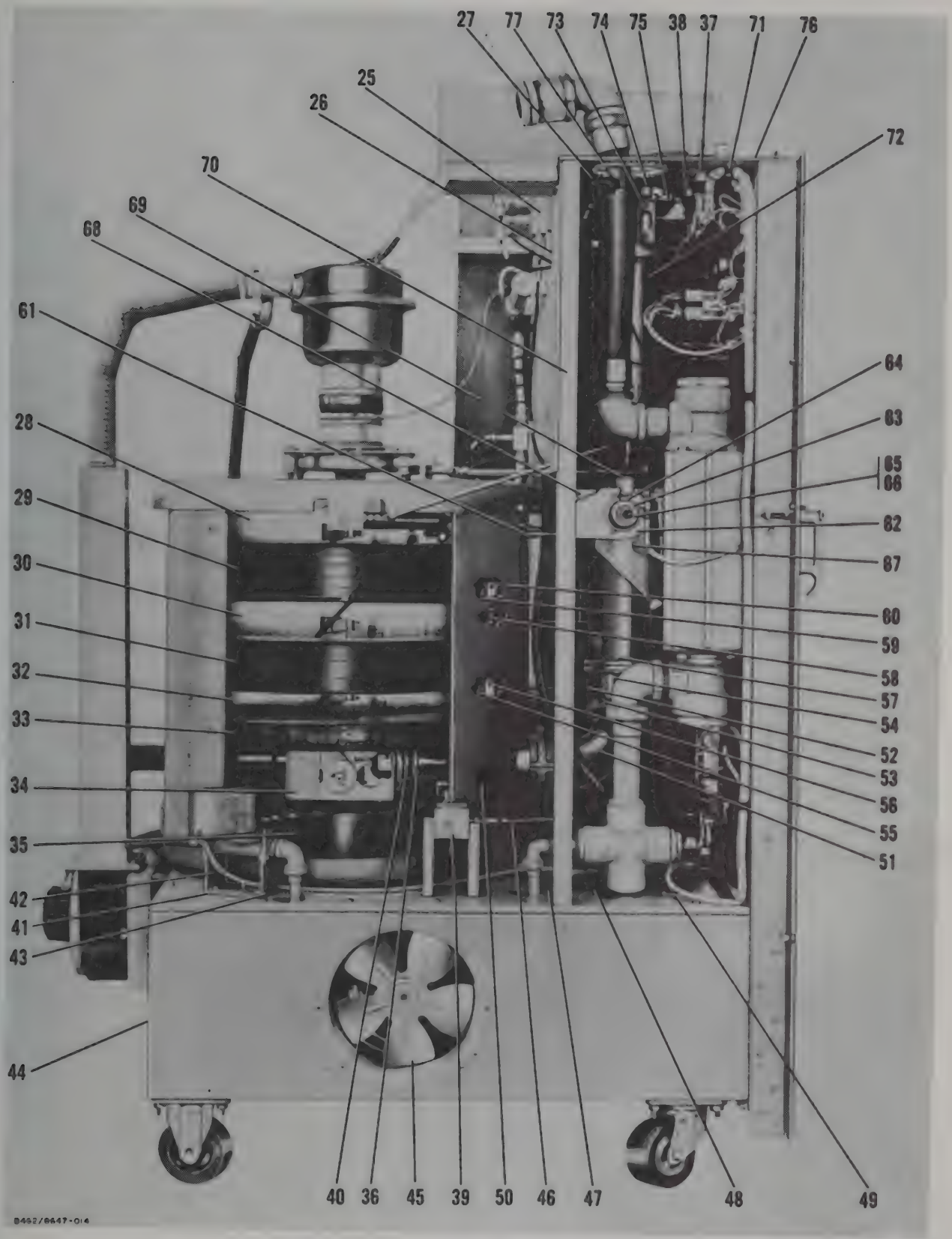


Figure 6-19. Radio Frequency Amplifier AM-2752/FRC-39A(V) and AM-3629/MRC-98 (Sheet 2 of 5)

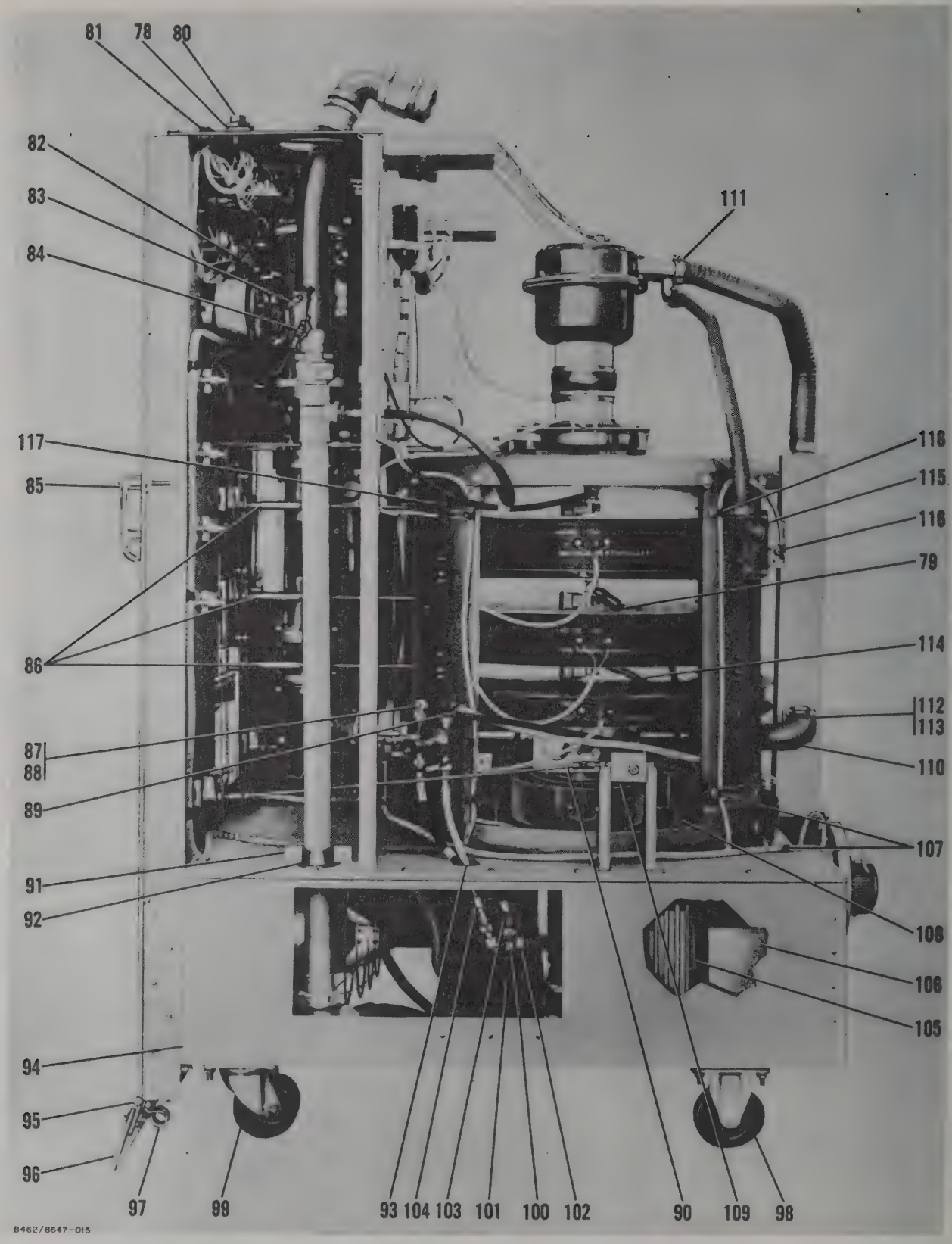


Figure 6-19. Radio Frequency Amplifier AM-2752/FRC-39A(V) and AM-3629/MRC-98 (Sheet 3 of 5)

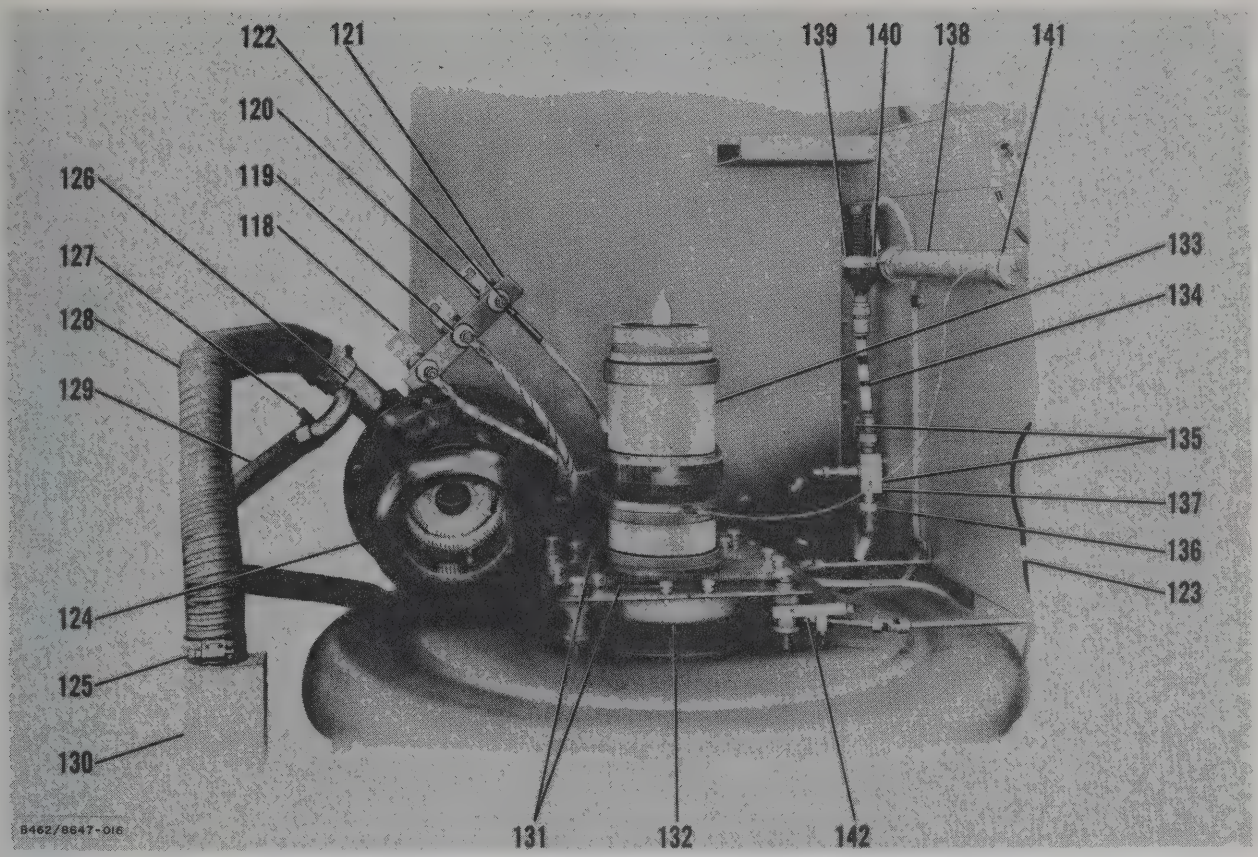


Figure 6-19. Radio Frequency Amplifier AM-2752/FRC-39A(V) and AM-3629/MRC-98 (Sheet 4 of 5)

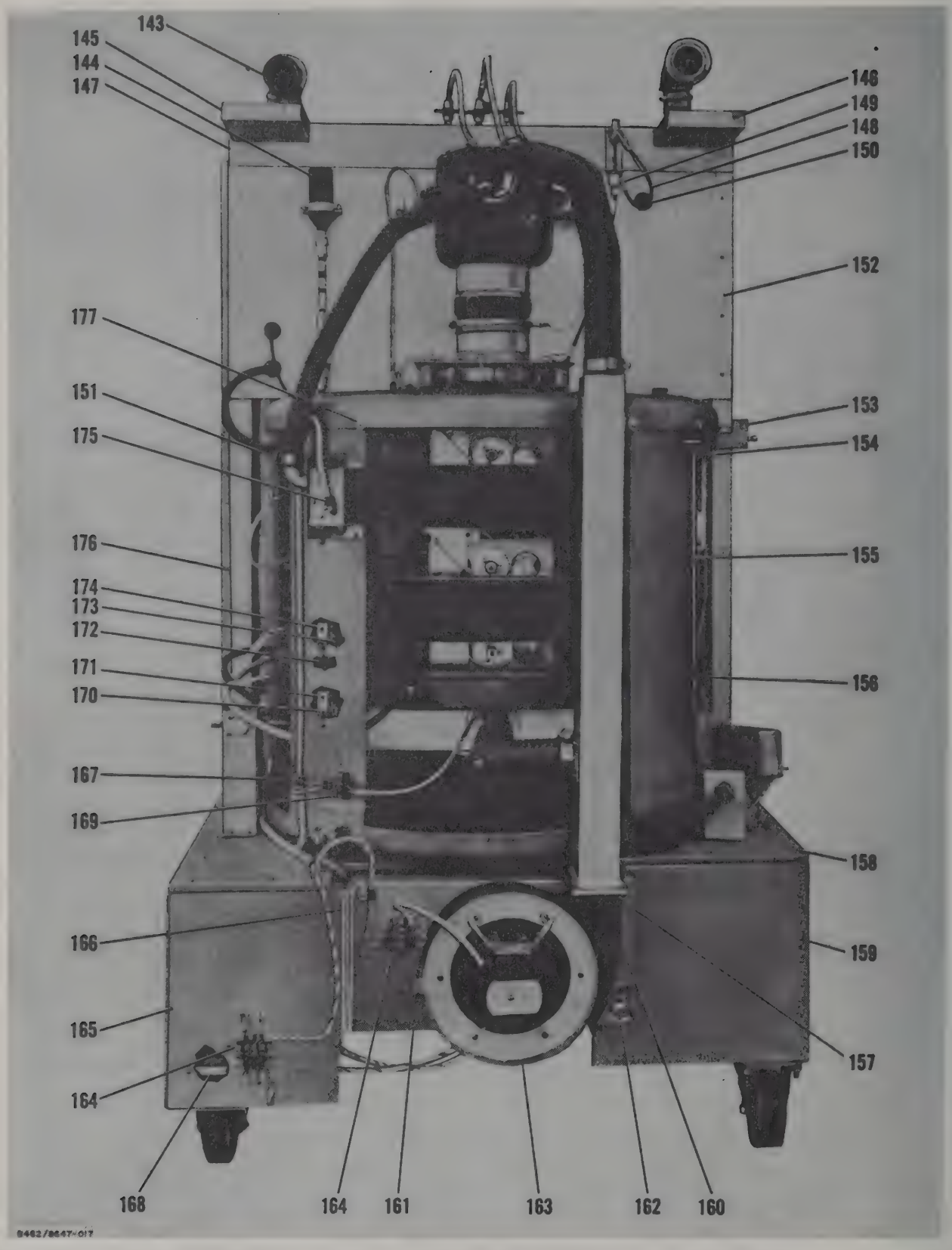


Figure 6-19. Radio Frequency Amplifier AM-2752/FRC-39A(V) and AM-3629/MRC-98 (Sheet 5 of 5)

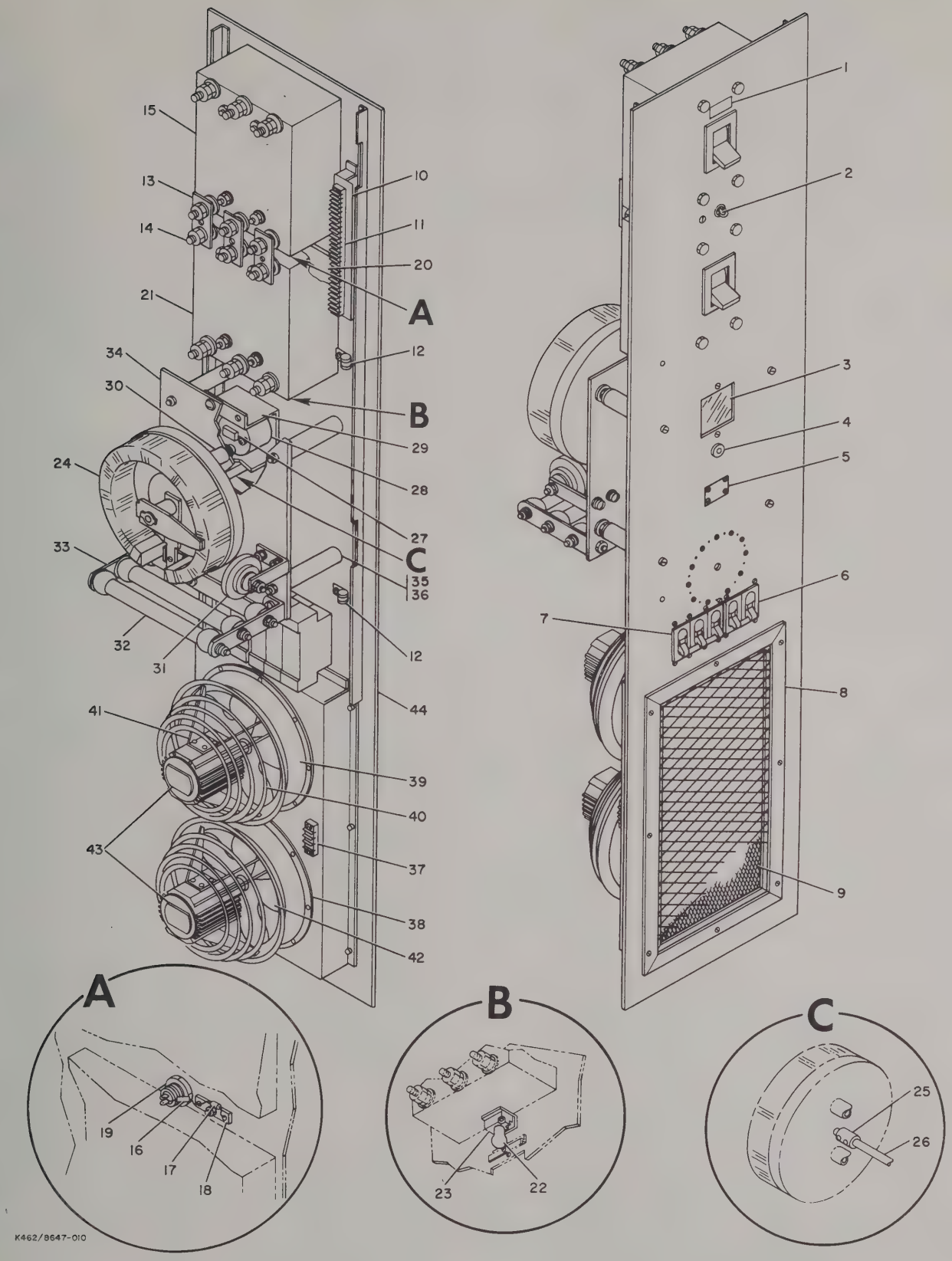


Figure 6-20. Power Distribution Panel SB-1192/FRC-39A(V) and SB-1847/MRC-98

APPENDIX A
BASIC ISSUE ITEMS

Section I. INTRODUCTION

A-1. Scope

This appendix lists items comprising an operable equipment and those required for installation, operation, or operator's maintenance for Amplifier-Power Supply Group OA–2973/FRC–39A-(V).

A-2. Explanation of Columns

The following is a list of explanations of columns in section II.

a. Source, Maintenance and Recoverability Codes (SMR) Column.

(1) *Source code (A).* The selection status and source for the listed item is the first code indicated in this column. The source codes used and their explanations are:

Code	*Explanation*
P	Applies to repair parts that are stocked in or supplied from GSA/DSA, or Army supply system, and authorized for use at indicated maintenance categories.
A	Applies to assemblies that are not procured or stocked as such but are made up of two or more units, each of which carries an individual stock number and description and is procured and stocked and can be assembled by units at indicated maintenance categories.

(2) *Maintenance code (B).* The lowest category of maintenance authorized to install the item is indicated by the second code in the column. The maintenance category code and its explanation is:

Code	*Explanation*
O	Organizational Maintenance

(3) *Recoverability code (C).* The recoverability code is the third code in the column. It indicates whether unserviceable items should be returned for recovery or salvage. Recoverability code and its explanation is as follows:

Note. When no code is indicated in the recoverability column, the part will be considered expendable.

Code	*Explanation*
R	Applies to repair parts and assemblies that are economically repairable at DSU and GSU activities and are normally furnished by supply on an exchange basis.

b. Federal Stock Number Column. This column indicates the Federal stock number for the item.

c. Description Column. This column indicates the Federal item name and any additional description of the item which may be required. A part number or other reference number is followed by the applicable five-digit Federal Supply Code for Manufacturers. The model column is not used.

d. Unit of Issue Column. The unit used as a basis of issue (e.g., ea, pr, ft, yd, etc.) is given in this column.

e. Quantity Incorporated in Unit Pack Column. Not used.

f. Quantity Incorporated in Unit Column. The total quantity of the item used in the equipment is given in this column.

g. Quantity Authorized Column. This column lists the quantity of the item supplied for initial operation of the equipment and/or the quantities authorized to be kept on hand by the operator for maintenance of the equipment.

h. Illustrations Column.

(1) *Figure number (a).* The number of the illustration in which the item is shown is indicated in this column.

(2) *Item or symbol number (b).* The item number and/or symbol number used to reference the item in the illustration appears in this column.

A-3. Federal Supply Codes

This paragraph lists the Federal supply code with the associated manufacturer's name.

Code	*Manufacturer*
24446	General Electric Co.
77633	Radio Engineering Laboratories
96906	Military Standards

(1) (A) SOURCE CD	(1) (B) MAINT. CD	(1) (C) REC. CODE	(2) FEDERAL STOCK NUMBER	MODEL 1	2	3	4	5	6	(3) DESCRIPTION	(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS (A) FIGURE NUMBER	(8) ILLUSTRATIONS (B) ITEM OR SYMBOL NUMBER
A	O	R	5895							AMPLIFIER- POWER SUPPLY GROUP OA-2973/FRC-39A(V): 77633; 954 (This item is nonexpendable)	ea				6-16	
										TECHNICAL MANUAL TM 11-5820-757-15						
										Requisition through pinpoint account number if assigned; otherwise through nearest Adjustant General facility.						
										NOTE: For technical manuals the quantity indicates the maximum number of copies authorized for packing (or issue) with the equipment. Where a number of these equipment are concentrated in a small area, the quantity on hand may be reduced to the minimum actual requirements as determined by the commanding officer of the unit.						
A	O	R	6130							BEAM POWER SUPPLY: 77633; PT1000-0A006	ea		1	1	6-16	14
A	O	R	5975							ELECTRICAL EQUIPMENT CABINET CY-2981/FRC-39A(V): 77633; A1850-0A001	ea		1	1	6-16	18
A	O	R	5805							MONITOR PANEL SB-1194/FRC-39A(V): 77633; A1855-0A001	ea		1	1	6-16	8
A	O	R	6110							POWER DISTRIBUTION PANEL SB-1192/FRC-39A(V): 77633; A1852-0A001	ea		1	1	6-16	7
A	O	R	6110							POWER DISTRIBUTION PANEL SB-1193/FRC-39A(V): 77633; A1854-0A001	ea		1	1	6-16	2

(1) (A) SOURCE CD	(1) (B) MAINT. CD	(1) (C) REC. CODE	(2) FEDERAL STOCK NUMBER	MODEL 1	2	3	4	5	6	(3) DESCRIPTION	(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS (A) FIGURE NUMBER	(8) ILLUSTRATIONS (B) ITEM OR SYMBOL NUMBER
										BASIC ISSUE ITEMS LIST						
A	O	R	6130							POWER SUPPLY CONTROL C-3395/FRC-39A(V): 77633; A1856-0B001	ea		1	1	6-16	16
A	O	R	6130							POWER SUPPLY CONTROL C-3396/FRC-39A(V): 77633; A1860-0C001	ea		1	1	6-16	4
A	O	R	6130							POWER SUPPLY CONTROL C-3397/FRC-39A(V): 77633; A1860-1C001	ea		1	1	6-16	5
A	O	R	6130							POWER SUPPLY CONTROL C-3398/FRC-39A(V): 77633; A1860-2D001	ea		1	1	6-16	6
A	O	R	6130							POWER SUPPLY PP-2744/FRC-39A(V): 77633; A1857-0A001	ea		1	1	6-16	3
A	O	R	6130							POWER SUPPLY PP-2745/FRC-39A(V): 77633; A1858-0B001	ea		1	1	6-16	12
A	O	R	5310							RADIO FREQUENCY AMPLIFIER AM-2752/FRC-39A(V): 77633; A1851-0A001	ea		1	1	6-16	9
P	O		5950							TRANSFORMER, POWER, VARIABLE: 77633; PT1095-0A001	ea		1	1	6-16	15
A	O	R	6120							VARIABLE POWER TRANSFORMER TF-355/FRC-39A(V): 77633; A1962-0A001	ea		1	1	6-16	13
										POWER DISTRIBUTION PANEL SB-1193/FRC-39A(V): 77633; A1854-0A001						
P	O		5920							FUSE: 96906; MS90078-9	ea		4	10	6-17	9
P	O		6240-223-9100							LAMP, GLOW: 24446; NE51	ea		42	4	6-17	15

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(1) SOURCE CD (A)	(1) MAINT. CD (B)	(1) REC. CODE (C)	(2) FEDERAL STOCK NUMBER	MODEL 1	2	3	4	5	6	(3) DESCRIPTION	(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS (A) FIGURE NUMBER	(8) ILLUSTRATIONS (B) ITEM OR SYMBOL NUMBER
										ELECTRICAL EQUIPMENT CABINET CY-2981/FRC-39A(V): 77633; A1850-0A001						
P	O		6240							LAMP, INCANDESCENT: 24446; 100A99	ea		2	1	6-18	36
										RADIO FREQUENCY AMPLIFIER AM-2752/FRC-39A(V): 77633; A1851-0A001						
P	O		6240							LAMP, INCANDESCENT: 24446; 15T7DC-120V	ea		1	1	6-19	65
										POWER DISTRIBUTION PANEL SB-1192/FRC-39A(V): 77633; A1852-0A001						
P	O		6240							LAMP, INCANDESCENT: 24446; 10C7	ea		1	1	6-20	22
										NO ACCESSORIES, TOOLS OR TEST EQUIPMENT ARE TO BE ISSUED WITH THIS EQUIPMENT						
										NO BASIC ISSUE ITEMS ARE MOUNTED IN OR ON THE EQUIPMENT						

APPENDIX B

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Amplifier-Power Supply Group OA–2973/FRC–39A. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2. Explanation of Format for Maintenance Allocation Chart

a. Group Number. Group numbers correspond to the reference designation prefix assigned in accordance with ASA Y32.16, Electrical and Electronics Reference Designations. They indicate the relation of listed items to the next higher assembly.

b. Component Assembly Nomenclature. This column lists the item names of component units, assemblies, subassemblies, and modules on which maintenance is authorized.

c. Maintenance Function. This column indicates the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Codes	*Maintenance Category*
C	Operator/Crew
O	Organizational Maintenance
F	Direct Support Maintenance
H	General Support Maintenance
D	Depot Maintenance

d. Tools and Equipment. The numbers appearing in this column refer to specific tools and equipment which are identified by these numbers in section III.

e. Remarks. Self explanatory.

B-3. Explanation of Format For Tool and Test Equipment Requirements

The columns in the tool and test equipment requirements chart are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number.

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1	AMPLIFIER-POWER SUPPLY GROUP OA-2973/FRC-39A	O											5	External
		F											6,7	Internal
			F										1 thru 4,6,7	Check voltages, continuity, resistance and frequency
							H						1 thru 4,6,7	Refer to T.O. 31R5-2FRC39-234
										O			4,5	Replace knobs, fuses, lamps
										F			1 thru 4,6,7	Replace defective parts
											H		1 thru 4,6,7	Restore to a serviceable condition
1A	POWER DISTRIBUTION PANEL SB1193/FRC-39A A1854-0A001	O											5	External
		F											6,7	Internal
			F										1 thru 4,6,7	Check voltages, continuity, resistance
										O			5	Replace knobs and fuses
										F			1 thru 4,6,7	Replace defective parts
1B	POWER SUPPLY PP-2744/FRC-39A A1857-0A001	O											5	External
		F											6,7	Internal
			F										1 thru 4,6,7	Check voltages, continuity and resistance
										F			1 thru 4,6,7	Replace defective parts
1C	POWER SUPPLY CONTROL C-3396-FRC-39A A1860-0C001	O											5	External
		F											6,7	Internal
			F										4,6,7	Check voltages, continuity, resistance and capacitance
										O			5	Replace lamp
										F			4,6,7	Replace defective parts

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	OA-2973/FRC-39A (continued)													
1D	POWER SUPPLY CONTROL C-3397/FRC-39A A1860-1C001	O											5	External
		F											6,7	Internal
			F										4,6,7	Check voltages, continuity and resistance
										O			4,5	Replace lamps
										F			4,6,7	Replace defective parts
1E	POWER SUPPLY CONTROL C-1860-2D001	O											5	External
		F											6,7	Internal
			F										4,6,7	Check voltages, continuity and resistance
										O			4,6,7	Replace lamps
										F			4,6,7	Replace defective parts
1F	POWER DISTRIBUTION PANEL SB-1192/FRC-39A A1852-0A001	O											5	External
		F											6,7	Internal
			F										4,6,7	Check voltages, continuity, capacitance and resistance
										O			4,6,7	Replace lamps
										F			4,6,7	Replace defective parts
1G	MONITOR PANEL SB-1194/FRC-39A A1855-0A001	O											5	External
		F											6,7	Internal
			F										4,6,7	Check voltages, continuity, capacitance and resistance
										O			4,5	Replace lamps
										F			4,6,7	Replace defective parts

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	OA-2973/FRC-39A (continued)													
1H	RADIO FREQUENCY AMPLIFIER AM-4752/FRC-39A A1851-0A001	O F	 F										5 6,7 1 thru 4,6,7	External Internal Check voltages, frequencies, continuity, capacitance and resistance
										O F			4,5 1 thru 4,6,7	Replace lamps, knobs, and fuses Replace defective parts
1I	POWER SUPPLY PP-2745/FRC-39A A1858-0B001	F	 F										6.7 4,6.7	Visual Check voltages, continuity, resistance and capacitance
										F			4,6,7	Replace defective parts
1J	VARIABLE POWER TRANSFORMER TF-3551/FRC-39A A1962-0A001	F	 F										6,7 4,6,7	Visual Check continuity, voltages, capacitance, and resistance
										F			4,6.7	Replace defective parts
1K	BEAM POWER SUPPLY PT-1000-0A006	F	 F										6,7 4,6,7	Visual Check continuity, voltages and resistance
										F			4,6,7	Replace defective parts
1L	POWER SUPPLY CONTROL C-3395/FRC-39A A1856-0B001	F	 F										6,7 4,6,7	Visual Check voltages, continuity, resistance and capacitance
										F			4,6,7	Replace defective parts

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
1	F,H	GENERATOR, SIGNAL AN/URM-49	6625-669-5131	
2	F,H	TEST SET, RADIOFREQUENCY TS-779/U	6625-739-1394	
3	F,H	BOLOMETER RF MX-2144A/U	6625-519-2414	
4	C,F,H	MULTIMETER AN/PSM-6B	6625-957-4374	
5	O	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-064-5178	
6	F,H	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-605-0079	
		OR		
7	F,H	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-610-8177	

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OA-4473/FRC-39A

CROSS-REFERENCE INDEX

(Prefix each Reference Number with the Chapter Number denoted by the Column.)
(KEY: Numbers preceded by "f" are illustrations; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 5		
				Org/Field Maintenance	Align-ment	Special Maintenance
AC Control Panel S1854 PANEL, POWER DISTRIBUTION SB-1193/FRC-39A(V)	5, f2	7, 9, 10, 11, 13, 14, 15, 16, f2, f3, t2	1, 2, 3, 8, 82, 86, 128, 171, 172, f16, t2	f3, t2		
Alarm Power Supply S1857 POWER SUPPLY PP-2744/FRC-39A(V)		15, f2, t2	8, 10, 27, 29, 30, 31, 32, 33, 34, 35, 194, 196, 197, 198, 200, 201, 204, 206, 208, 210, 212, 214, f1, f2, f5, f22, f23, f24, f25, f26, f27, f28	25, t2, t4		
AMPLIFIER-POWER SUPPLY GROUP OA-2973/FRC-39A(V) 10 KW Power Amplifier 954	1, 2, 5, 7, 9, 11, 13, 21, 25, 27, 28, 31, 32, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 49, 52, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21, f22, t1, t2	2, 5, 7, 11, 13, 14, 17, 19, f1, f2, f3, f4, f5, f6, t1, t2, t3, t4, t5, t6, t7, t8	1, 2, 4, 8, 12, 14, 16, 18, 20, 22, 27, 36, 38, 40, 43, 50, 58, 61, 62, 70, 71, 77, 82, 86, 88, 91, 93, 97, 99, 101, 108, 114, 115, 118, 126, 128, 131, 135, 140, 143, 171, 194, f1, f2, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21, f22, f23, f24, f25, f28	1, 2, 4, 6, 8, 10, 12, 14, 44, 47, 49, 51, 53, 55, 57, 59, 61, 62, 64, 65, 68	17, 22, 23, 25, 32, 38, 42, 44, 47, f1, f2, f3, f4, f5, f6, f7, f8, f9	49, 51, 53, 55, 57, 59, 61, 62, 64, 65, 68, 71, 74, 76, 80, 83, 86

CROSS-REFERENCE INDEX (cont)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 5		
				Org/Field Maintenance	Align-ment	Special Maintenance
AMPLIFIER-POWER SUPPLY GROUP OA-4408/MRC-98 10 KW Power Amplifier 954B	1, 2, 5, 7, 9, 11, 13, 21, 25, 27, 28, 31, 32, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 49, 52, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21, f22, t1, t2	2, 5, 7, 11, 13, 14, 17, 19, f1, f2, f3, f4, f5, f6, f9, t5, t6, t7, t8	1, 2, 4, 8, 12, 14, 16, 18, 20, 22, 27, 37, 38, 40, 43, 50, 58, 61, 62, 70, 71, 77, 82, 86, 88, 91, 93, 97, 99, 101, 108, 114, 115, 118, 126, 128, 131, 135, 140, 143, 171, 194, f1, f2, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21, f22, f23, f24, f25, f28	1, 2, 4, 6, 8, 10, 12, 14, 44, 47, 49, 51, 53, 55, 57, 59, 61, 62, 64, 65, 68	17, 22, 23, 25, 32, 38, 42, 44, 47, f1, f2, f3, f4, f5, f6, f7, f8, f9	49, 51, 53, 55, 57, 59, 61, 62, 64, 65, 68, 71, 74, 76, 80, 83, 86
AMPLIFIER-RADIO FREQUENCY AM-3629/MRC-98 Klystron Carriage S1858-2	32, 34, 36, 37, 38, 39, 40, 41, 42, 46, 47, 49, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f29, f21	1, 2, 5, f5, t6	2, 12, 14, 16, 18, 20, 27, 28, 36, 38, 41, 44, 50, 58, 60, 61, 62, 70, 71, 77, f2, f3, f5, f6, f7, f8, f9, f10, f11	44, 47, f3	17, 22, 23, 24, 25, 26, 28, 30, 32, 36, f3	53, 55, 56, 59
AMPLIFIER-RADIO FREQUENCY AM-2752/FRC-39A(V) Klystron Carriage S1851	32, 34, 36, 37, 38, 39, 40, 41, 42, 46, 47, 49, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f21, f29	1, 2, 5, f5, t6	2, 12, 14, 16, 18, 20, 27, 28, 36, 38, 41, 44, 50, 58, 60, 61, 62, 70, 71, 77, f2, f3, f5, f6, f7, f8, f9, f10, f11	44, 47, f3	17, 22, 23, 24, 25, 26, 28, 30, 32, 36, f3	53, 55, 56, 59

Beam Power Primary Control S1856 CONTROL, POWER SUPPLY C-3395/FRC-39A(V)	7, 11, 13, 25, 27, 28, 31, f2, f4, t1	f6, f7	121, 122, 123 124, 125, 174			68, 70
Beam Power Primary Control CONTROL, POWER SUPPLY C-6126/URA-48 S1856-1	7, 11, 13, 25, 27, 28, 31, f2, f4, t1	f6, t7	121, 122, 123, 124, 125, 174			68, 70
Beam Regulator Control Panel S1860-2 CONTROL, POWER SUPPLY C-3398/FRC-39A(V)	18	f2, t2, t3	172, 204, f20		34, t2, t4	
CABINET, ELECTRICAL EQUIPMENT CY-2981/FRC-39A(V) 10 KW Power Amplifier Cabinet S1850	1, 2, 5, 7, 9, 11, 13, 18, f10, f22, t1, t2	f1				
CABINET, ELECTRICAL EQUIPMENT CY-3794/MRC-98 10 KW Power Amplifier S1850-3	1, 2, 5, 7, 9, 11, 13, 18, f10, f22, t1, t2	f1				
CONTROL, POWER SUPPLY C-3395/FRC-39A(V) Beam Power Primary Control S1856	7, 11, 13, 25, 27, 31, f2, f4, t1	f6, t7	121, 122, 123, 124, 125, 174			68, 70
CONTROL, POWER SUPPLY C-3396/FRC-39A(V) 120 Volt Regulator Control S1860		14, 15, 16, f2, t3	8, 22, 82, 86, 101, f13		30, f1, t2, t4	
CONTROL, POWER SUPPLY C-3397/FRC-39A(V) Field Coils Regulator Control S1860-1	34	2, 5, 11, 14, 15, 16, f2, t2, t3, t5	12, 13, 14, 15, 16, 17, 18, 20, 115, 187, f4, f5, f14, f21	f2, t2, t3, t4	32	
CONTROL, POWER SUPPLY C-3398/FRC-39A(V) Beam Regulator Control Panel S1860-2	18	f2, t2, t3	172, 204, f20		34, t2, t4	
CONTROL, POWER SUPPLY C-6126/URA-48 Beam Power Primary Control S1856-1	7, 11, 13, 25, 27, 28, 31, f2, f4, t1	f6, t7	121, 122, 123, 124, 125, 174			68, 70
Distribution Panel S1852 PANEL POWER DISTRIBUTION SB-1192/FRC-39A(V)		15, 16, 17, 18, 19, 20, f3, t3	86, 143, 171, f3, f4, f12, f15, f17, t4			
Distribution Panel S1852-2 PANEL POWER DISTRIBUTION SB-1847/MRC-98		15, 16, 17, 18, 19, 20, f3, t3	86, 143, 171, f3, f4, f12, f15, f17, t4			

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 5		
				Org/Field Maintenance	Align-ment	Special Maintenance
Field Coils Regulator Control S1860-1 CONTROL POWER SUPPLY C-3397/FRC-39A(V)	34	2, 5, 11, 14, 15, 16, f2, t2, t3, t5	12, 13, 14, 15, 16, 17, 18, 20, 115, 187, f4, f5, f14, f21	f2, t2, t3, t4	32	
Field Coils Variable Auto Transformer S1962 TRANSFORMER, VARIABLE POWER TF-335/FRC-39A(V)	34, f3, f6, t2	15, f2, t2	12, 22, 104, 117, 150, 151, 152, 153, f3, f4, f21	5, t2, t3		
Focus Coils Power Supply S1858 POWER SUPPLY PP-2745/FRC-39A(V)		15, 71, 144, f3, f10, f17, t2, t5, t6	14	36, 37, f3, t4		
Klystron Carriage S1858-2 AMPLIFIER, RADIO FREQUENCY AM-3629/MRC-98	32, 34, 36, 37, 38, 39, 40, 41, 42, 46, 47, 49, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21	1, 2, 5, f5, t6	2, 12, 14, 16, 18, 20, 27, 28, 29, 36, 38, 41, 44, 50, 58, 60, 61, 62, 70, 71, 77, f2, f3, f5, f6, f7, f8, f9, f10, f11	44, 47, f3	17, 22, 23, 24, 25, 26, 28, 30, 32, 36 f3	53, 55, 56, 59
Klystron Carriage S1851 AMPLIFIER, RADIO FREQUENCY AM-2752/FRC-39A(V)	32, 34, 36, 37, 38, 39, 40, 41, 42, 46, 47, 49, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21	1, 2, 5, t6	2, 12, 14, 16, 18, 20, 27, 28, 29, 36, 38, 41, 44, 50, 58, 60, 61, 62, 70, 71, 77, f2, f3, f5, f6, f7, f8, f9, f10, f11	44, 47, f3	17, 21, 23, 24, 25, 26, 28, 30, 32, 36, f3	53, 55, 56, 59
Meter Panel S1855 PANEL MONITOR SB-1194/FRC-39A(V)		2, 15, f1, f4, t5	77	20, f11, t3, t4		
PANEL MONITOR SB-1194/FRC-39A(V) Meter Panel S1855		2, 15, f1, f4, t5	77	20, f11, t3, t4		

PANEL POWER DISTRIBUTION SB-1192/FRC-39A(V) Distribution Panel S1852		15, 16, 17, 18, 19, 20, f3, t3	86, 143, 171, f3, f4, f12, f15, f17, t4			
PANEL POWER DISTRIBUTION SB-1193/FRC-39A(V) AC Control Panel S1854	5, f2	7, 9, 10, 11, 13, 14, 15, 16, f2, f3, t2	1, 2, 3, 8, 82, 86, 128, 171, 172, f16, t2	f3, t2		
PANEL POWER DISTRIBUTION SB-1847/MRC-98 Distribution Panel S1852-2		15, 16, 17, 18, 19, 20, f3, t3	86, 143, 171, f3, f4, f12, f15, f17, t4			
POWER SUPPLY PP-2744/FRC-39A(V) Alarm Power Supply S1857		15, f2, t2	8, 10, 27, 29, 30, 31, 32, 33, 34, 35, 194, 196, 197, 198, 200, 201, 204, 206, 208, 210, 212, 214, f1, f2, f5, f22, f23, f24, f25, f26, f27, f28	25, t2, t4		
POWER SUPPLY PP-2745/FRC-39A(V) Focus Coils Power Supply S1858		15, 71, 144, f3, f10, f17, t2, t5, t6	14	36, 37, f3 t4		
TRANSFORMER, VARIABLE POWER TF-355/FRC-39A(V) Field Coils Variable Auto Transformer S1962	34, f3, f6, t2	15, f2, t2	12, 22, 104, 117, 150, 151, 152, 153, f3, f4, f21	5, t2, t3		
10 KW Power Amplifier Cabinet S1850-2 CABINET, ELECTRIC EQUIPMENT CY-3794/MRC-98	1, 2, 5, 7, 9, 11, 13, 18, f10, f22, t1, t2	f1				
10 KW Power Amplifier Cabinet S1850-3 CABINET, ELECTRICAL EQUIPMENT CY-2981/FRC-39A(V)	1, 2, 5, 7, 9, 11, 13, 18, f10, f22, t1, t2	f1				

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 5		
				Org/Field Maintenance	Align-ment	Special Maintenance
10 KW Power Amplifier 954 AMPLIFIER-POWER SUPPLY GROUP OA-2973/FRC-39A(V) and 10 KW Power Amplifier 954B AMPLIFIER-POWER SUPPLY GROUP OA-4408/MRC-98	1, 2, 5, 7, 9, 11, 13, 21, 25, 27, 28, 31, 32, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 49, 52, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21, f22, t1, t2	2, 5, 7, 11, 13, 14, 17, 19, f1, f2, f3, f4, f5, f6, t1, t2, t3, t4, t5, t6, t7, t8	1, 2, 4, 8, 12, 14, 16, 18, 20, 22, 27, 36, 38, 40, 43, 50, 58, 61, 62, 70, 71, 77, 82, 86, 88, 91, 93, 97, 99, 101, 108, 114, 115, 118, 126, 128, 131, 135, 140, 143, 171, 194, f1, f2, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16, f17, f18, f19, f20, f21, f22, f23, f24, f25, f28	1, 2, 4, 6, 8, 10, 12, 14, 44, 47, 49, 51, 53, 55, 57, 59, 61, 62, 64, 65, 68	17, 22, 23, 25, 32, 38, 42, 44, 47, f1, f2, f3, f4, f6, f7, f8, f9	49, 51, 53, 61, 62, 64, 65, 68, 71, 74, 76, 80, 83, 86
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